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ABSTRACT

This instructional package is one of two designed for use by regular vocational students in the vocational area of small engine repair service. Contained in this document are forty-four learning modules organized into ten units: engine block; air cleaner; starters; fuel tanks; lines, filters, and pumps; carburetors; electrical; magneto systems; lubrication; gear boxes and drive trains; and sharpening and grinding mowers. Each module includes these elements: a performance objective page telling what will be learned, what materials will be needed, and how the student will be evaluated; an information page (not always included) provides information needed to perform the activity; and job step pages which detail steps necessary to do the tasks. Visuals are included with the explanation. (This document and CE 017 580 are one of three sets of learning modules on small engine repair. The other two sets are written in formats designed for visually impaired and low reader/educable mentally impaired students. The modules are part of a total set of over 1,300 written for different student populations. Building maintenance, dietetic assistant, medical assistant, and graphics are the other vocational areas covered.) (JH)

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CAPITAL AREA CAREER CENTER
Ingham Intermediate School District
611 Hagadorn Road
Mason, Michigan 48854

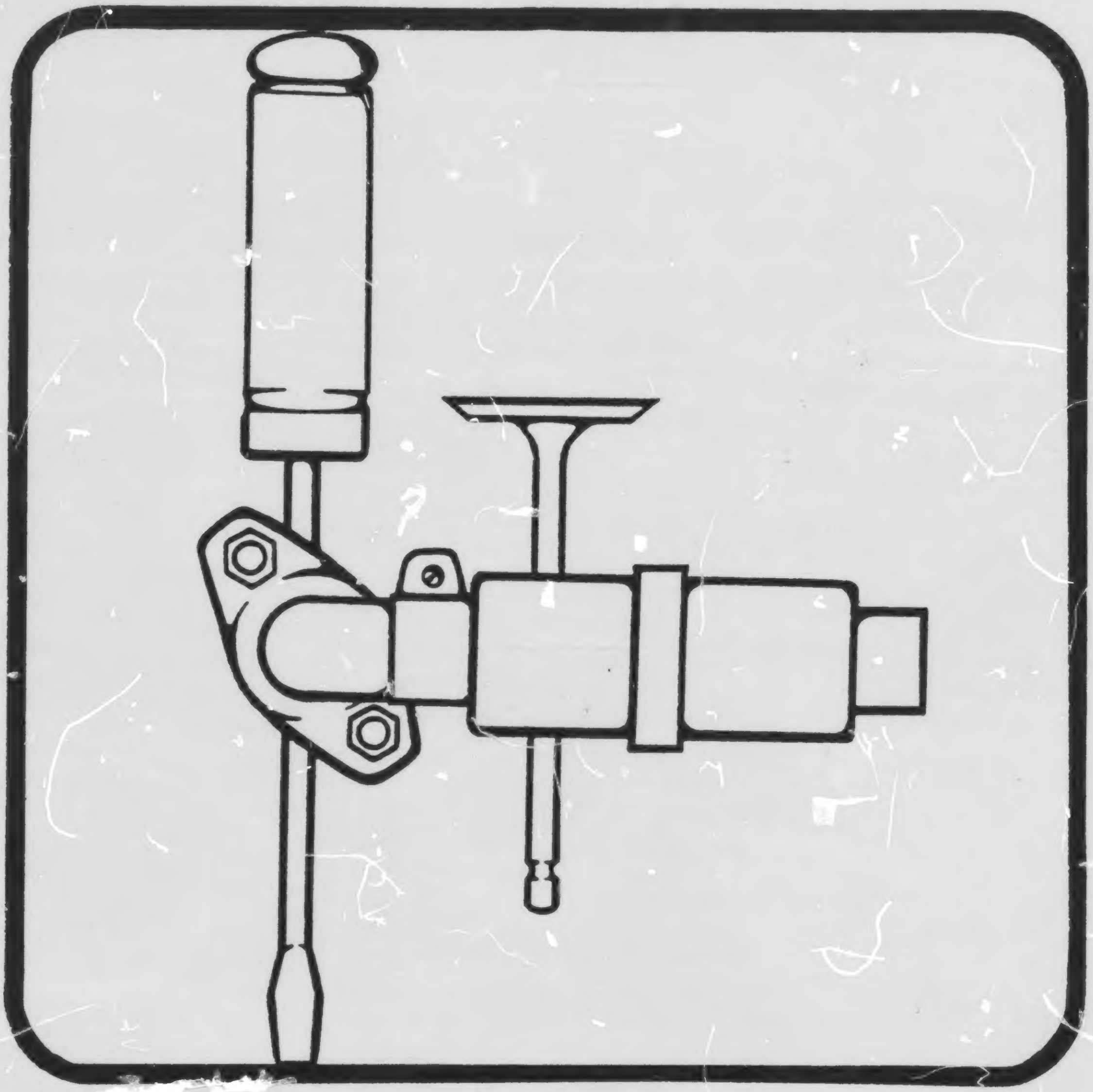
TO:

MULTIPLE LEARNING STRATEGIES PROJECT

SMALL ENGINE REPAIR SERVICE
Regular Vocational

[VOL. 1]

CE 017 579



small engine repair

unit: Engine Blocks

capital area career center

module: 7501 01 001 date: January 1978 level: I

skill title: Remove and Replace Engine Base Sump and Lower Seal

developed & written by: Jim Pitts

visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to remove and replace the engine base sump and oil seals on a 92902 Briggs and Stratton Engine.

AND IN ORDER TO DO THIS YOU WILL NEED:

Briggs and Stratton Engine - model 92902

New oil seal

Hand tools and seal installer

Torque specification chart

Torque wrench

Brass hammer

WE WILL KNOW YOU CAN DO IT WHEN:

You have replaced the sump and oil seal so that it does not leak when the engine is running and according to specifications.

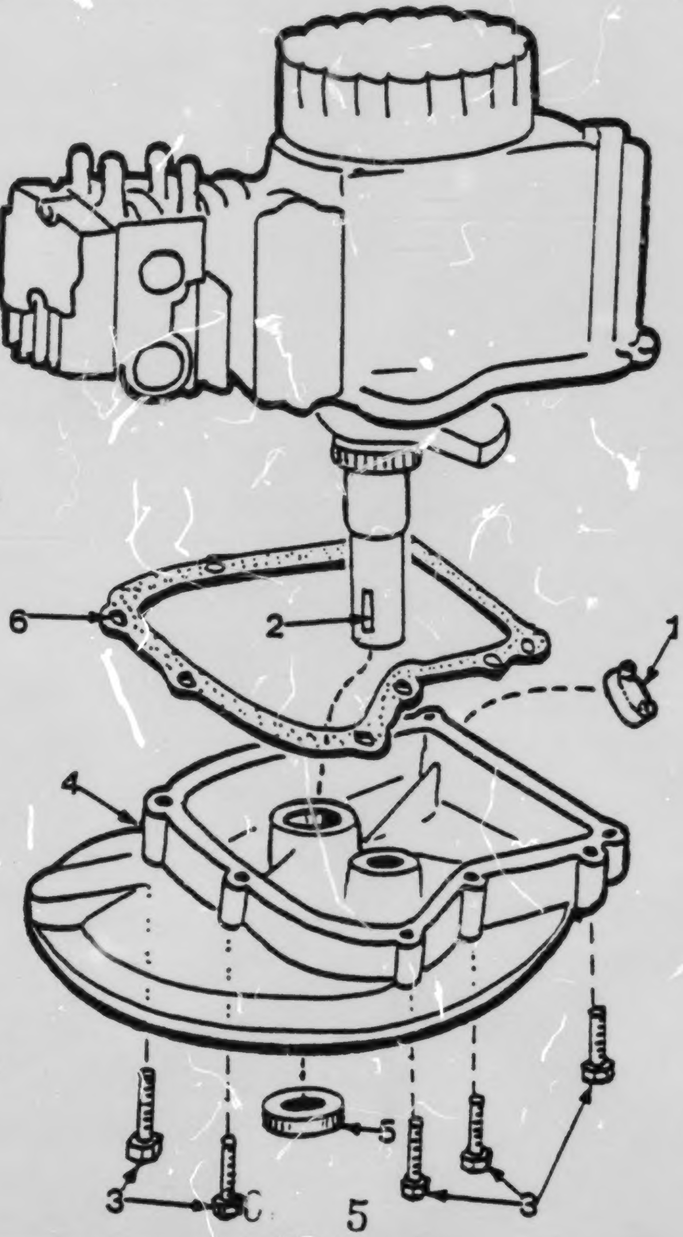
INFORMATION

When the sump oil seal begins to leak, you will have to replace it. You must be careful when putting in new seals. They should be lubricated and if possible, use a seal protection. The seal protector fits over the shaft so the seal will not tear when it slides on.

You will also have to look up the specifications for crankshaft end play in the service manual for the engine with which you are working.

The picture below of the model 92000 series Briggs & Stratton engine will help you identify the parts.

1. Engine Oil Drain
2. Crankshaft at PTO End
3. Sump Bolts
4. Sump Flanges
5. Oil Seal
6. Gasket

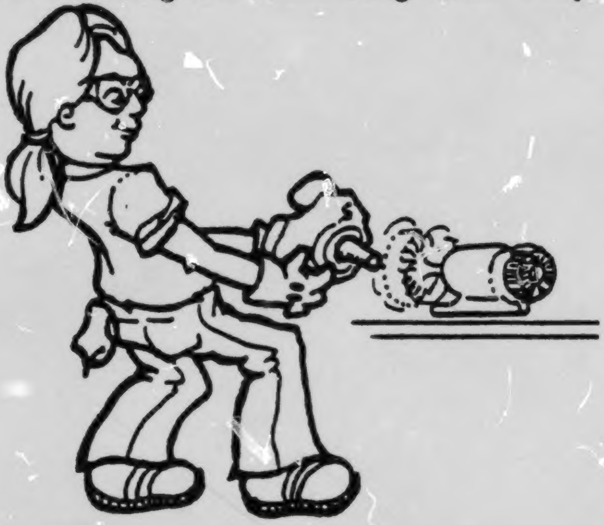


WORD GUIDE

DOWEL	Alignment pin.
EMERY CLOTH	Cloth with rough surface used to sand and polish.
LUBRICATE	Make slippery with grease or oil to reduce friction.

JOB STEPS

1. Get all equipment and go to work area.
2. Clean the outside of the engine by removing all loose dirt and grease from the engine block.
3. Drain engine oil.
4. Drain or shut off gas supply.
5. Holding engine firmly, clean the end of the crankshaft on wire buffing wheel or, using oil, oleum mixture and emery cloth, clean rust or dirt from crankshaft, and power take-off end. (This will prevent binding and scarring when sump is taken out.)



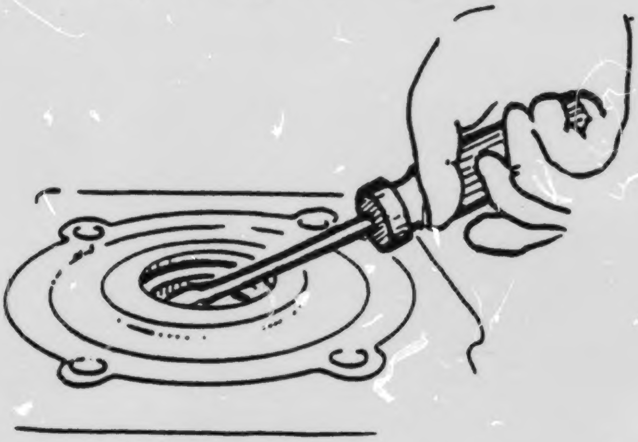
6. Using speed handle and socket, remove sump bolts.

JOB STEPS

7. Using a rubber, brass, or lead mallet, gently tap (from side to side, top to bottom) the sump flanges until sump comes free.

8. Grasping the sump with both hands (using a rocking motion), slide the sump off the crank shaft end. If sump does not slide freely, crank extension has not been cleaned well. Go back and clean the crank extension.

9. Drive oil seal out from this top side or, place a large screwdriver under the seal and push down on the handle until the seal pops out. Don't put screw driver too far under seal as it could scar the back of the seal hole.

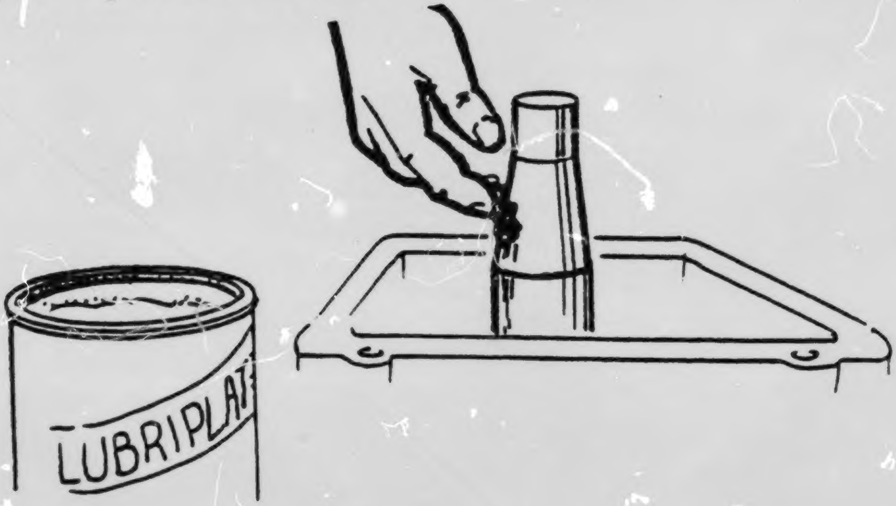


10. Using gasket scraper, clean old gasket from the block.

11. Install new gasket on block and align gasket on alignment dowels.

12. Push in new oil seal.

13. Replace sump. Lubricating the crankshaft to prevent damage to new oil seal and to allow the sump to slide freely. Use lubriplate grease on shaft.



small engine repair

unit: Engine Blocks

capital area career center

module: 7501 01 002 date: June 1977 level:

skill title: Remove and Replace Sump on Auxiliary P. T. O. Type Briggs & Stratton Engine

developed & written by: Don Foster & Jim Pitts

visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to remove and replace sump and oil seal on a Briggs & Stratton Engine with an auxiliary P. T. O.

IN ORDER TO DO THIS YOU WILL NEED:

A Briggs & Stratton engine with auxiliary P. T. O.

Socket set

Torque wrench

Screwdriver set

Oil drain pan

Briggs & Stratton Repair Instruction Manual IV

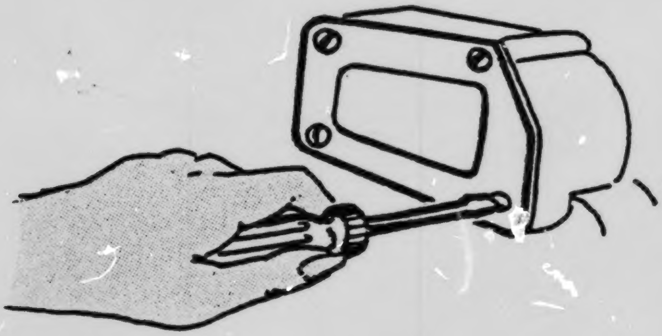
Safety glasses

WE WILL KNOW YOU CAN DO IT WHEN:

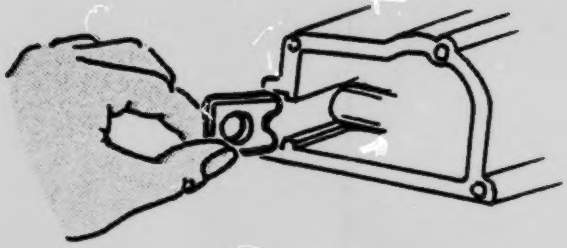
You have replaced the sump and oil seal on the engine according to specifications, so the seal does not leak when the engine is running.

JOB STEPS

1. Get all equipment and go to your work area. Wear safety glasses.
2. Clean loose dirt and grease from the engine.
3. Drain oil.
4. Drain or shut off fuel.
5. Clean crankshaft, using wire wheel on grinder or oleum and emery cloth to clean P. T. O. end of crankshaft.
6. Remove four screws holding auxiliary drive cover in place and then remove cover.

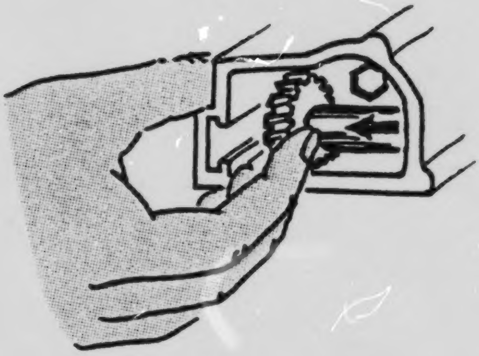


7. Lift out shaft stop.



JOB STEPS

8. Slide gear and shaft sideways to expose sump bolts.



9. Remove all sump bolts.

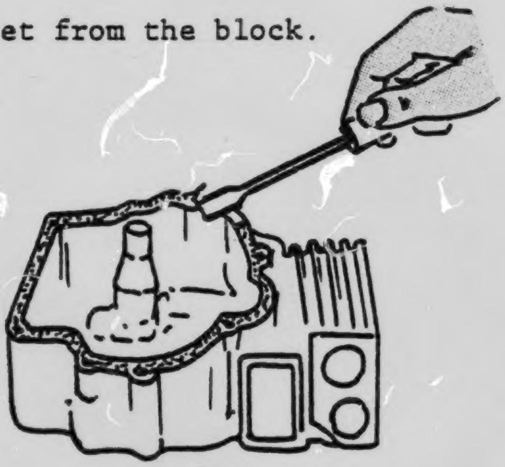
10. Using a rubber mallet, tap lightly on sump to loosen the sump.

11. Grasp the sump with both hands and twist back and forth. Then slide the sump off end of crankshaft.

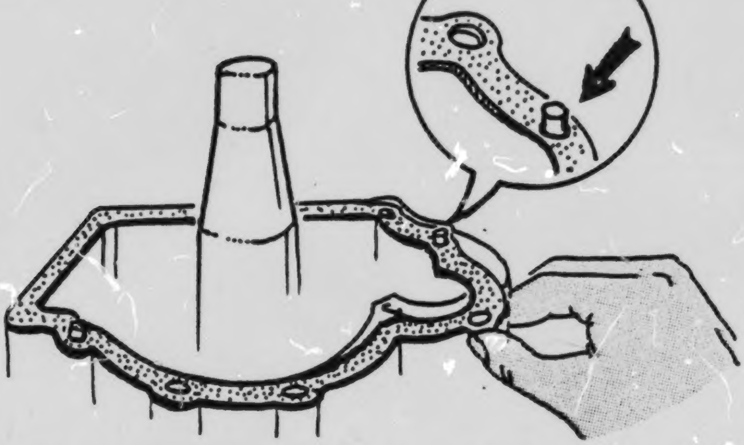
12. Place sump upside down on work bench. Place a large screwdriver under the edge of the seal and push down on handle of screwdriver until seal pops out. (See picture in Mod 7501 01 001.)

    NOTE: Don't put screwdriver too far under seal as it could scar the back of the seal hole causing it to leak.

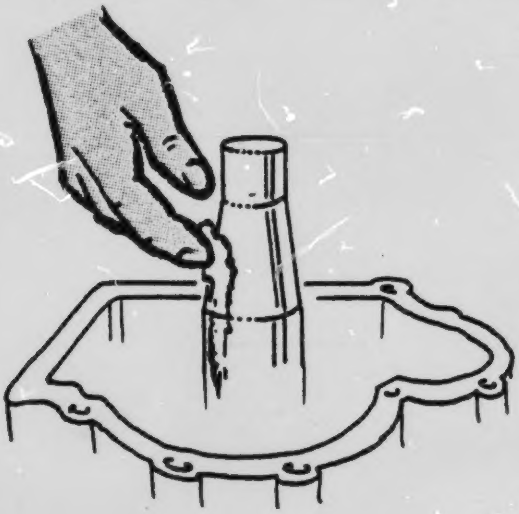
13. Clean old gasket from the block.



14. Install new gasket on block and align gasket on alignment dowels.



15. Put lubriplate on crankshaft to allow sump to slide freely.



16. Install sump.

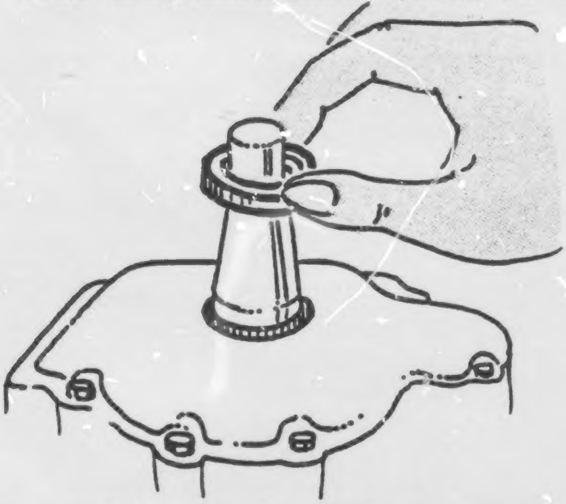
17. Install two sump bolts and tighten to proper torque from Torque Specification Chart.

18. Check end play. If you don't know how to check it, refer to Mod 7501 01 017 on checking end play.

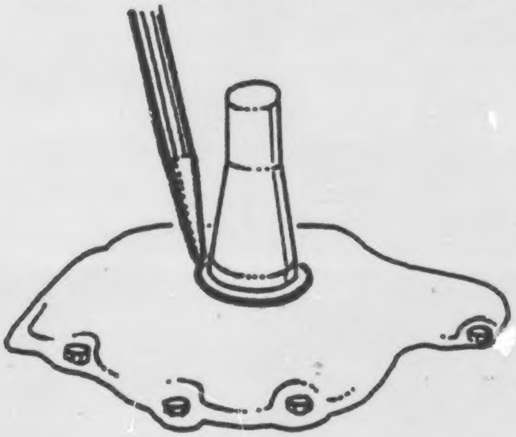
19. If end play is OK, install rest of sump bolts and torque. If not, see your instructor.

20. Apply proper seal protector or tape crank to protect seal from scratches.

21. Gently slide seal down crankshaft until it touches the sump.



22. Now, drive the seal in flush with the sump.



23. Check for engine binding by turning flywheel.

24. Install new auxiliary cover gasket and cover and tighten screws.

25. Fill with oil and fuel.

26. Start and then check for oil leak.

27. Have your instructor check your work.

small engine repair

unit: Engine Block

capital area career center

module: 7501 01 003 date: 6/77 level:

skill title: Remove Cylinder Head, Check For Warp, Attach To Block And Torque

developed & written by: Jim Pitts

visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to remove cylinder head, check head for warp, attach to block and torque according to service manual specifications.

AND IN ORDER TO DO THIS YOU WILL NEED:

- Engine block
- Surface block
- Feeler gauge
- Socket set
- Torque wrench
- Wire brush
- Belt sander
- Safety glasses

WE WILL KNOW YOU CAN DO IT WHEN:

You have flattened the cylinder head and gotten the engine to run without any gasket leak.

WORD GUIDE

CYLINDER (HEAD) - Metal section bolted to top of block.

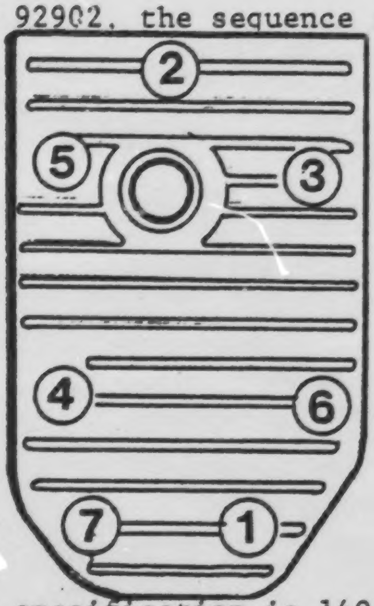
INFORMATION

You need to know how to remove a cylinder head, inspect and service it and how to properly put it back on the block.

When you take the screws out of the head, be sure to see if some are different lengths. If some are, be sure to put them back in the right holes.

You must also check the service manual for proper head screw tightening sequence and torque specifications.

For a B & S model 92902, the sequence is:



The proper torque specification is 140 inch pounds. Be sure not to use gasket cement on the head gasket.

WORD GUIDE

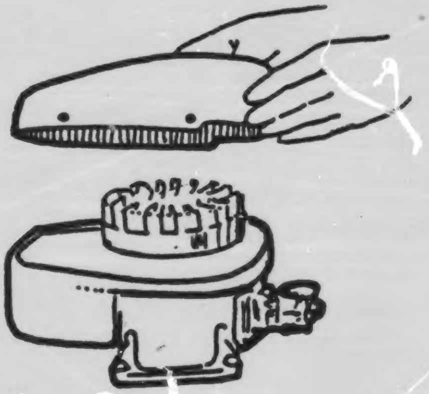
SEQUENCE - Series, correct order of steps.

JOB STEPS

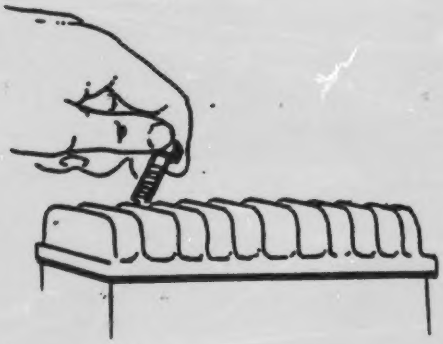
1. Get all equipment and go to your work area. Be sure to wear your safety glasses.

2. Clean loose dirt and grease from the block and head.

3. Remove shroud, if it is attached to the head.



4. Remove cylinder head screws.

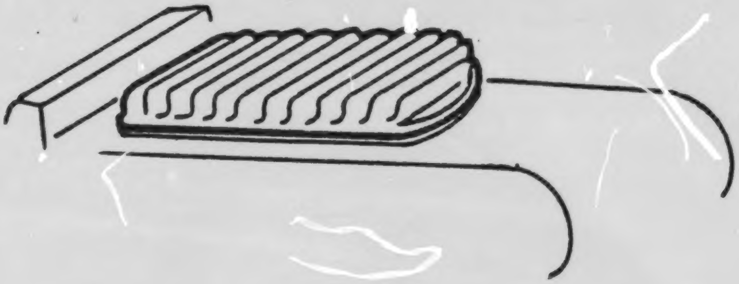


JOB STEPS

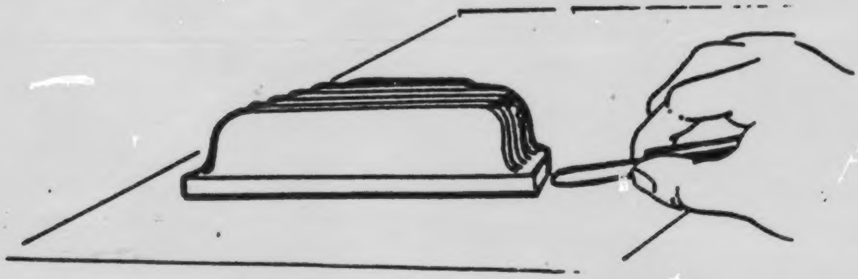
5. Using wire brush and carbon scraper, clean carbon from piston head, block and top of the piston.

6. Using wire brush, clean the head pins.

7. Lay head on belt sander. Hold lightly but firmly on sander. Then, turn on sander and allow to run about 30 seconds. Turn off sander and check surface of head. If it isn't level or smooth repeat this step.



8. Put the head on a surface plate to be sure it is flat. Use a thickness gauge to check it.



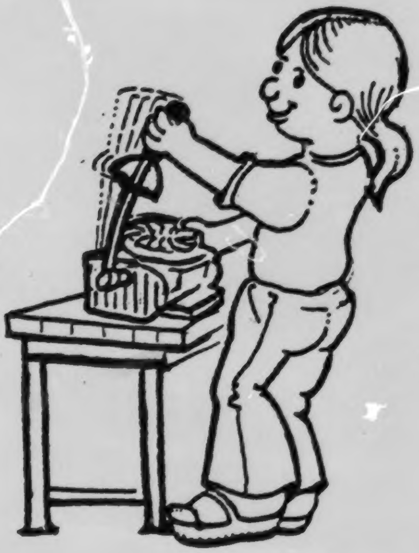
JOB STEPS

9. Install new gasket on the block.

10. Install head on new gasket.

11. Install head screws and torque. Be sure to use the proper tightening sequence and to tighten each screw slowly.

12. Using a torque wrench, tighten bolts to proper torque specifications.



13. Replace shroud.

14. Check oil level.

15. Start the engine and visually check for leaks around the gasket.

16. Shut off the engine.

JOB STEPS

17. Re-torque the head bolts.

18. Ask your instructor to check your work.

19. Put away all equipment.

small engine repair

unit: ENGINE BLOCK

capital area career center

module: 7501 01 004 date: 6/77 level:

skill title: Servicing Camshafts

developed & written by: Jim Pitts

visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to remove camshaft and tappets, check camshafts for cracks, chipped teeth or worn lobes, mike, journals, and install camshaft.

AND IN ORDER TO DO THIS YOU WILL NEED:

Briggs and Stratton Four-cycle Engine

Hand tools

Torque wrench

Micrometer

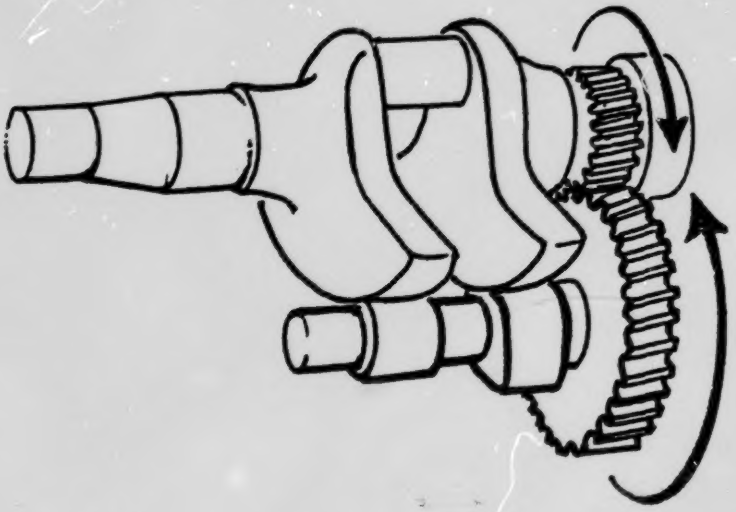
Safety glasses

WE WILL KNOW YOU CAN DO IT WHEN:

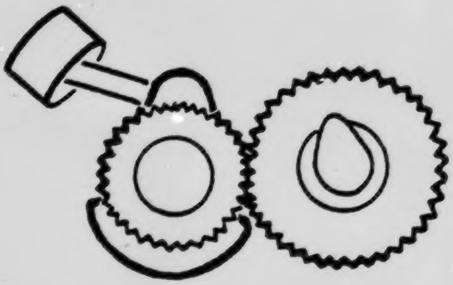
You have removed the camshaft and tappets, checked the camshaft for cracked or chipped teeth and worn lobes; installed the camshaft and timed it to the crankshaft according to service specifications.

INFORMATION

The camshaft makes the valves work. Small engines usually have one camshaft. The camshaft has one lobe for each valve. When the camshaft goes around it lifts the valve from its seat.



Camshafts are made of steel or cast iron. The surfaces are hardened to make the camshaft wear longer. Most small engines have gears that mesh with the crankshaft gear. The camshaft and crankshaft turn together. Camshafts have twice as many teeth as crankshafts. If the teeth on the cam gear are damaged, the camshaft will have to be replaced; also, the crankshaft gear will have to be replaced. If it isn't, the old crankshaft gear will ruin the new camshaft gear.



JOB STEPS

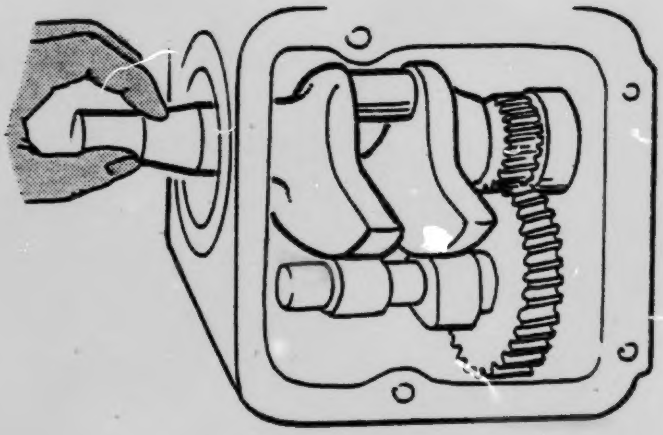
1. Get the engine you are to work on from your instructor. Wear your safety glasses!

2. Remove the engine sump, as in module 7501 01 001 or 7501 01 002.

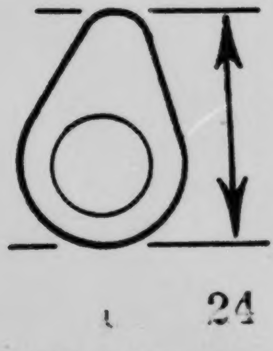
3. Remove camshaft.

4. The tappets may fall out when the camshaft is taken out. Be sure to see where the tappets came from. They must be put back in order.

5. Look at the cam gear teeth for chips and cracks.

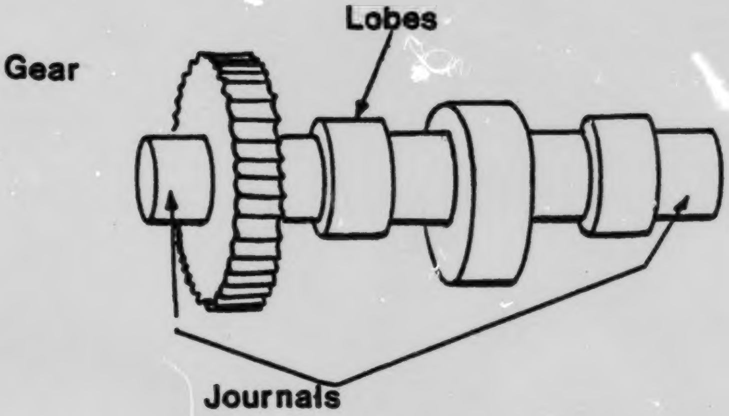


6. Measure cam lobes for wear. Look up the specification in the service manual.



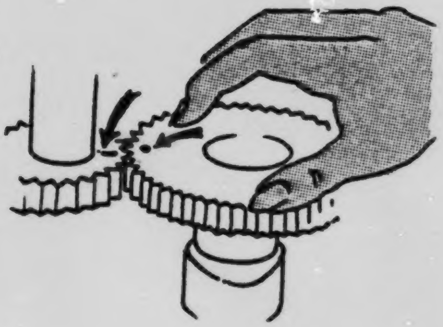
JOB STEPS

7. Check camshaft journals for wear. Look up the specification.



8. Put the tappets back in the same way they came out.

9. Find the timing mark on the crankshaft. Turn the crankshaft so the mark on the crankshaft gear and camshaft gear are aligned.



10. Install the camshaft.

11. Install the sump. Be sure to use new gaskets and seal. See mod 7501 01 001 or 7501 01 002. Be sure to torque all bolts.

JOB STEPS

12. Check the engine oil. Start the engine to be sure it runs.

13. Have your instructor check your work.

small engine repair

unit: ENGINE BLOCK

capital area career center

module: 7501 01 009 date: 6/77 level: IV

skill title: Check Rod and Rod Cap For Scorring, Replace Piston To Rod, Compress Piston Rings, and Install Pistons, and Torque Cap Nuts and Bolts

developed & written by: Don Foster and Jim Pitts

visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

You are going to learn:

How to disassemble, inspect and clean engine parts; install rings, pistons, crankshaft, and check valve timing.

And in order to do this you will need:

Engine

Hand tools

Torque wrench

Ring compressor

Micrometer

Ring groove cleaner

Ring expander

Feeler gauge
Safety Glasses

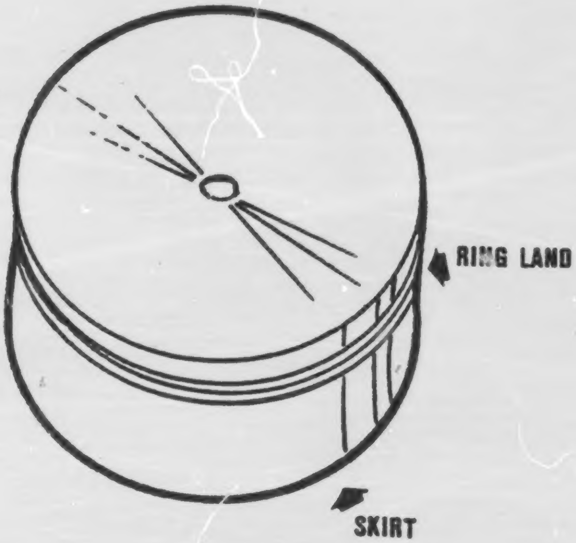
We will know you can do this when:

You have disassembled and inspected the engine parts, cleaned the engine parts, installed rings, piston and crankshaft and checked valve timing according to service manual specifications.

INFORMATION

This is some information you will need about pistons.

Now all pistons are perfectly round. Some are cam ground; that means that they are wider one way than the other. The widest side is usually the opposite direction of the wrist pin holes. The reason for a cam ground piston is for a more uniform fit after the piston gets hot and expands. If you have any questions check with your instructor. Notice also that the piston is usually smaller in diameter at the ring land area of the piston than the skirt area of the piston.



INFORMATION

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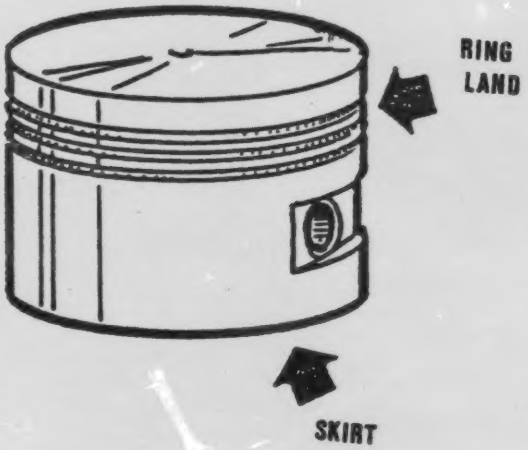
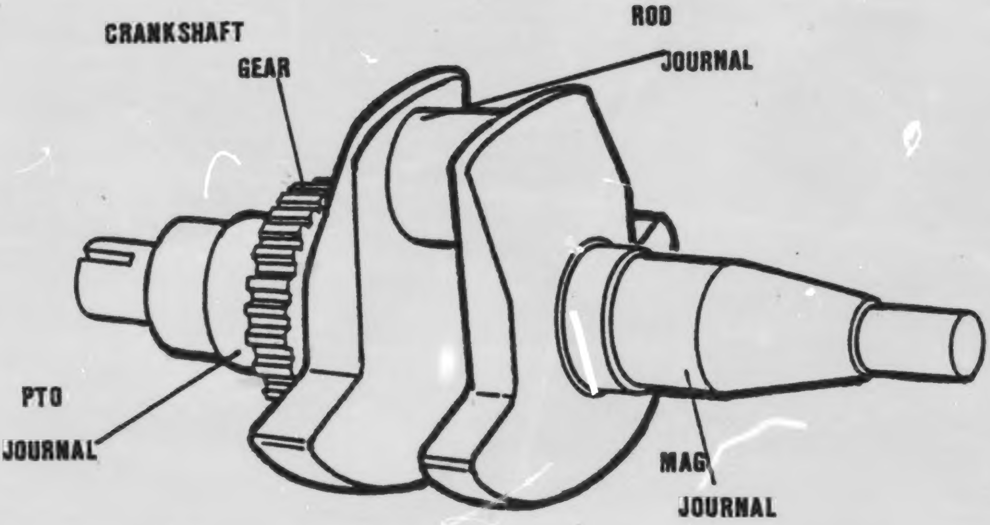


INFORMATION

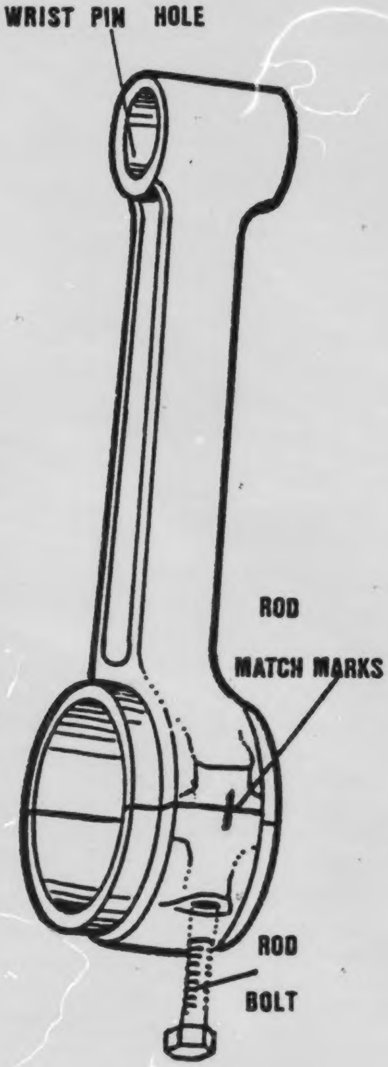
Study these crankshaft illustrations and be sure you know the different parts.

C


CRANKSHAFT
GEAR
ROD
JOURNAL
PTO
JOURNAL
MAG
JOURNAL

INFORMATION

Study these connecting rod illustrations and be sure you know the different parts.


WRIST PIN HOLE
ROD
MATCH MARKS
ROD
BOLT

JOB STEPS

1. Get the engine you are going to work on from your instructor. Wear your safety glasses.

2. Remove head and air housing.

3. Drain oil.

4. Remove flywheel if the engine is:

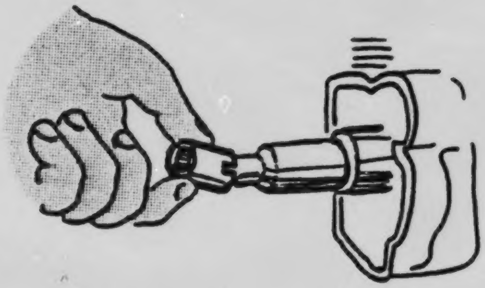
   a. Briggs - It can be pulled with a special puller or if a knock off is available it will be quicker to remove the flywheel with the knock off.

   b. Tecumseh - Some flywheels can be removed with a puller, if the flywheel has puller holes. If it doesn't, a knock off will have to be used to remove the flywheel.

   c. Clinton - You can use the knock off on all flywheels.

   d. Kohler - Always use a puller and the bolt holes provided in the flywheel, because the crankshaft will possibly break or fracture when struck with a hammer. Some Kohler engines use ceramic magnets and can be broken when hammered to remove the flywheel. Always use pullers on Kholer engines to remove flywheel.

5. If the engine has a removable point cam, now is the time to remove it. Just pull it off of the crankshaft. Clinton and Tecumseh usually have removeable point cams. Briggs doesn't.

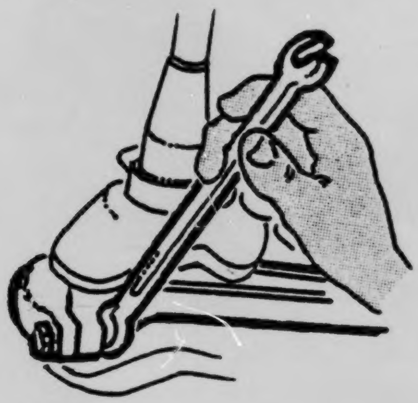


32-A

JOB STEPS

6. Remove sump as you learned in module 7501 01 001.

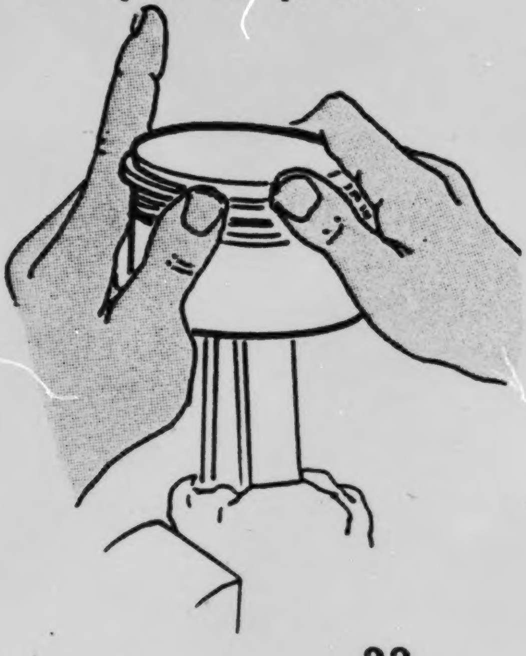
7. Remove rod bolts or nuts.



8. Look at rod and the way it is installed on the crankshaft before removing rod and piston from the block.

9. To remove rod and piston, push upward with one hand and with other hand be ready to hold piston as it comes out of the cylinder.

10. Remove piston rings, starting with the top ring first. Take all rings off the top of the piston.



WORD GUIDE

SCORRING - Scrapes, Scratches.

GALLING - Looks similar to a weld on the piston and like a rip in the cyliner.

JOB STEPS

11. Study the drawing of the piston in the Information Section of this module.

12. Inspect cylinder for noticable damage. Check for scoring in all types of cylinders. On cylinders that are chromeplated check for peeling chrome; on aluminum cylinders check for galling.

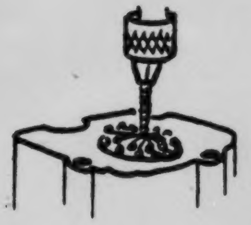
13. If there is no apparent damage to the cylinder go on. If there is, see your instructor.

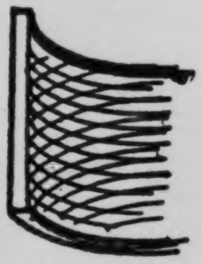
14. Now remove the crankshaft.

15. Check bearing journals (Rod Journal on throw and mag and P.T.O. side of crankshaft. Refer to the drawing of the crankshaft in the Information Section.

16. Remove oil seals from the block and sump. Refer to module 7501 01 001.

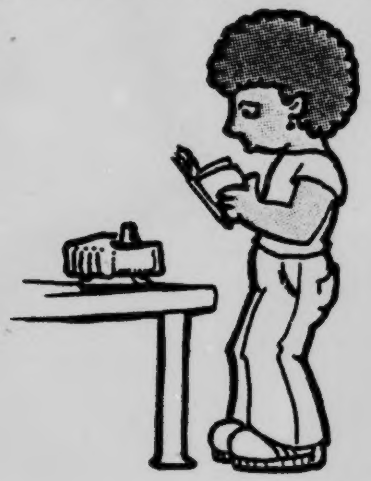
17. Deglaze the cylinder. Refer to module 7501 06 004.





JOB STEPS

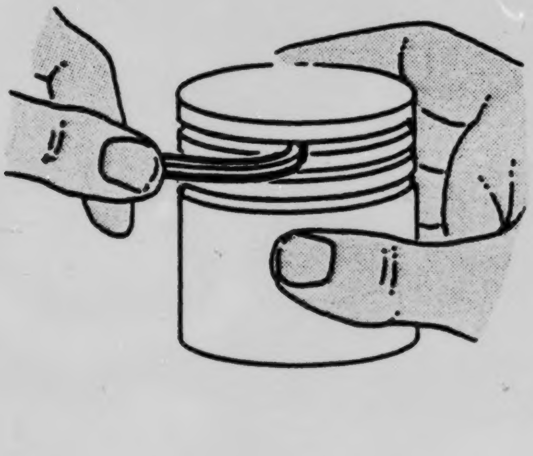
18. Check clearance specifications for particular engine model in manual.



19. Next hold onto the rod and put the piston in the cylinder. Use a feeler gauge of the right size and check clearance. Always check clearance on side of piston opposite wrist pin holes.

20. Now list all parts you will need to reassemble the engine properly (seals, gasket set rings, etc.). On the work order try to get all the parts you need.

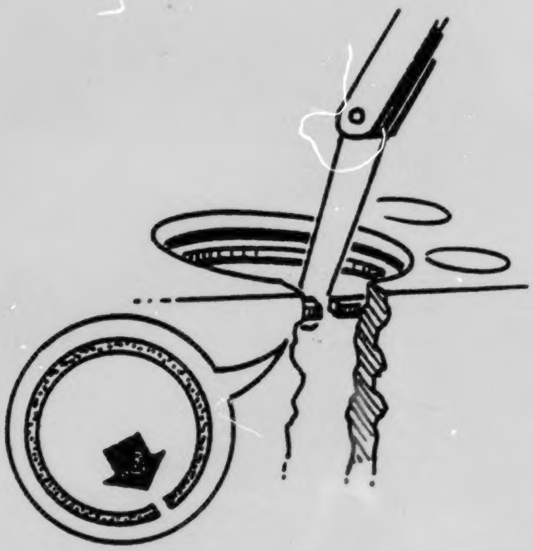
21. Clean ring grooves with a ring groove cleaner. If there isn't one available, break one of the old rings in two and grind one end flat and the other sharp.



JOB STEPS

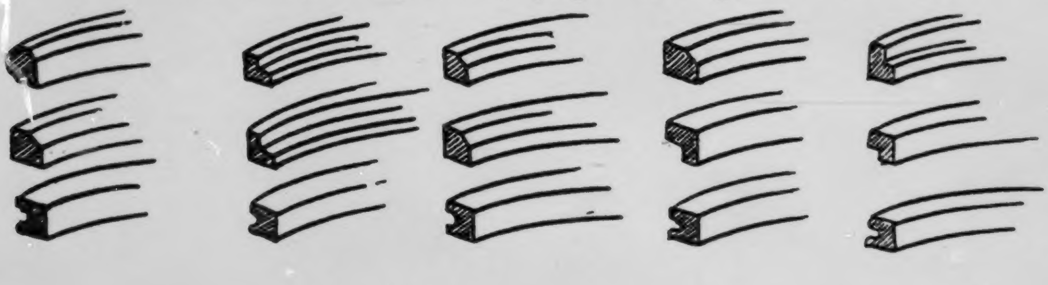
22. Put rings into the cylinder, then push the ring down into the cylinder to the bottom of the ring travel.

23. Now you should check the ring end gap. This information should be in the manual. If there isn't a manual available, a good rule of thumb would be to figure .003 minimum end gap per inch of diameter of the ring sample (2 inch ring, .006 gap, 2½" ring .009, 3" ring .009).



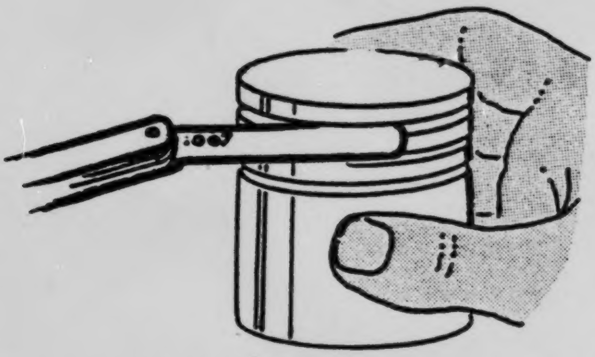
24. If end gap is OK, clean the entire engine. If not, check with your instructor.

25. Put rod and piston in vise (clamp very lightly on rod). Install the rings on the piston and be sure that they are in the proper groove and installed in the right way up. See B & S Manual IV, Section 9, page 3, figure 7 and 8.



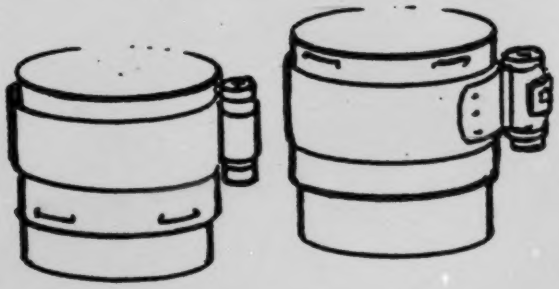
JOB STEPS

26. Now you are ready to check ring land clearance. (Read in Repair Manual IV, section 9, page 2 before checking). The ring land clearance is checked by placing the proper feeler gauge between the ring and the ring land. If clearance is greater than called for the piston will have to be replaced. If ring land clearance is OK, go on to next step.



27. Now you will put a light coating of oil on the piston rings and piston skirt. Be sure to stagger ring end gaps.

28. Now put the piston ring compressor on piston. Refer to B & S Manual IV, section 9, page 3, figure 8. Read pages 3 and 4.



29. Now coat the mag side main journal of the crankshaft with oil or lubriplate, and install crankshaft in the block.

30. Now you will install the rod and piston into the cylinder with the rod facing in the proper direction. Gently push the piston and rod down into the cylinder. See B & S Manual IV, section 9, page 4, figure 10.

31. Push piston downward and guide the rod to the crankshaft throw. Be sure to install the rod cap so that the match marks line up. Be sure the oil splasher, if used on the rod, is on before installing bolts or nuts. See B & S Manual IV, section 9, page 4, figure 11.

JOB STEPS

32. Torque the rod bolts or nuts. See manual for specifications. Be sure to bend rod lock to bolt head, if lock is used. The rod bolts and nuts are sometimes called cap screws.

33. Have your instructor inspect rod bolts and bent rod locks.

34. Now if the camshaft was taken out you must install the lifters and camshaft and retime to crank, after installing cam and aligning the timing marks. See B & S Manual, section 10, page 3.

35. You should check the valve to piston timing in case the cam or crankshaft is marked wrong.

36. To check valve timing, rotate crankshaft to T.D.C. between exhaust stroke and intake stroke by slowly turning the crankshaft back and forth. The piston should remain at top dead center and both valves should just barely move. (If both valves don't move then you may be on the compression stroke and will have to rotate the crankshaft one more complete revolution to T.D.C.). See if both valves move and the piston is not moving. This step is to prove that the engine is in proper valve to piston time.

37. Remove the crankshaft seal from the sump and clean up the sump for installation. See B & S Manual, section 10, page 4, figure 10, 11, and 12. Refer to mod 7501 01 001.

38. Install the new gasket on the block. (If the gasket is wrinkled or shrunk just soak it in warm water for a minute). Then lay it on block. Be sure alignment dowels are in place to hold the gasket.

39. Put oil or lubriplate on camshaft bearing and crankshaft bearing surface. If the engine has a mechanical governor or oil slinger (B & S) be sure it is installed at this time.

JOB STEPS

40. Install the sump on the crankshaft and carefully push the sump down and be sure to align camshaft with bearing hole. Don't force the sump down. (If the engine is a Tecumseh and it has a mechanical governor be sure that the nylon governor gear is in mesh with the cam gear). You may have to turn the crankshaft back and forth to get the gear to mesh. Then gently push the sump the rest of the way down.

41. Install sump bolts and torque. See manual.

42. Install oil seal in sump. See mod 7501 01 001.

43. Install new head gasket. See mod 7501 01 003.

44. Install head and torque. Check manual.

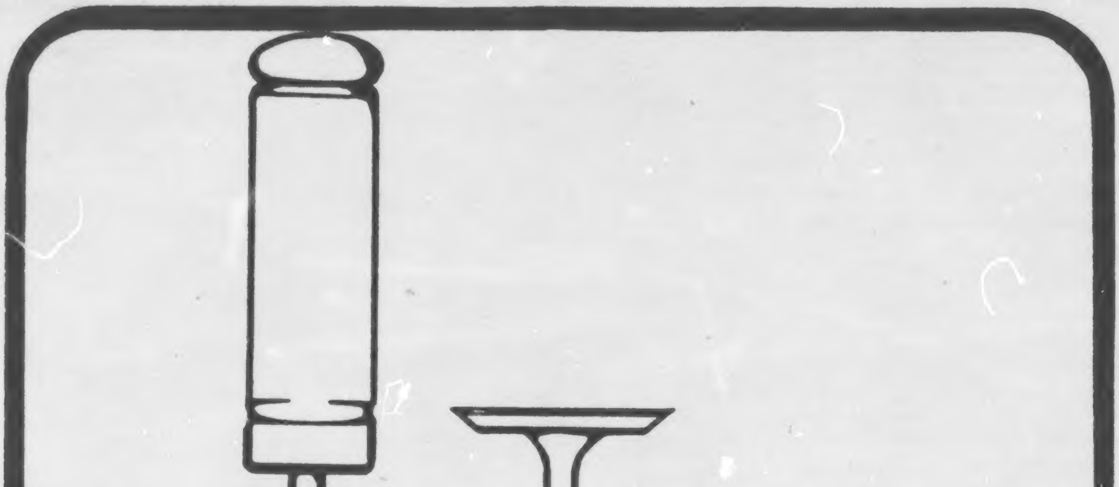
45. Install air housing.

46. Fill engine with oil and fuel.

47. Start and adjust. Check for oil leaks then shut off and check torque on head bolts.

48. Clean up for customer pick-up.

49. Have the instructor check your work.



small engine repair

unit: ENGINE BLOCK

capital area career center

module: 7501 01 016 date: June 1977 level:

skill title: Remove and Replace Oil Seal Power Products

Two Cycle Engine

developed & written by: Don Foster

visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

To remove and replace the lower oil seal in a power products engine.

AND IN ORDER TO DO THIS YOU WILL NEED:

1/4" electric drill
1/8" punch
Screwdriver set
Power products Two Cycle Engine
Drill index set
Seal pick
Prick punch

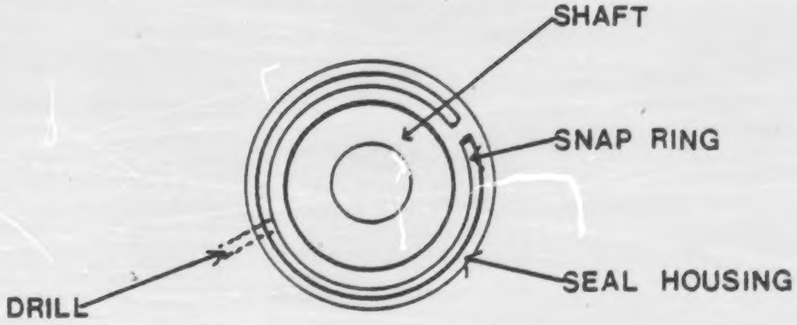
WE WILL KNOW YOU CAN DO IT WHEN:

The lower oil seal in a power products engine has been replaced so it does not leak.

INFORMATION

You do not have to disassemble a power products engine to replace the crankcase oil seal.

Study the drawing below. Be sure that you can name all the parts.


SHAFT
SNAP RING
SEAL HOUSING
DRILL

JOB STEPS

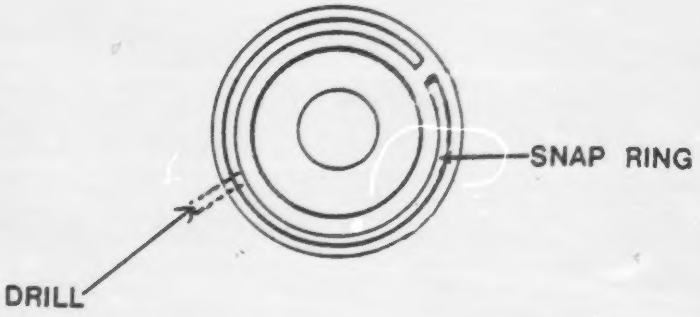
1. Clamp the engine upside down in a vise. Be careful not to damage engine. It must be held firm.

2. Get 1/8" drill bit from drill index.

3. Be sure you are wearing safety glasses.

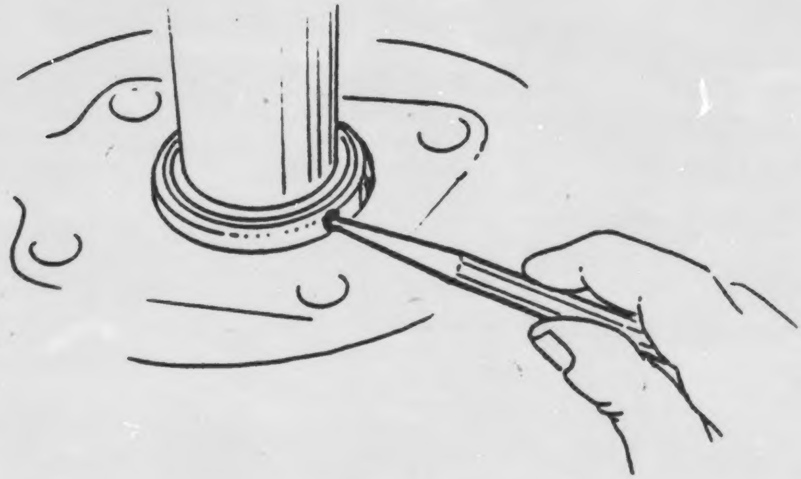
4. Put drill bit into drill motor.

5. After looking at the drawing you will see where you want to prick punch to prepare to drill the 1/8" hole. The hole must go in to the snap ring.

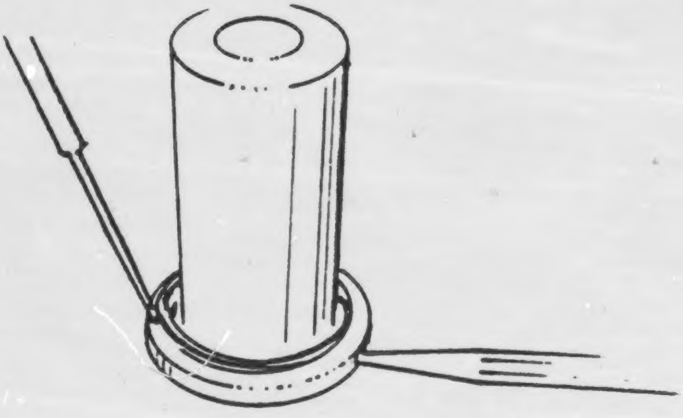


JOB STEPS

6. After drilling hole, push punch into hole to remove snap ring.

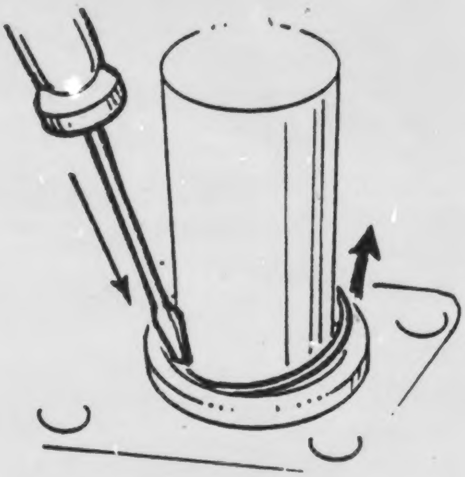


7. Hold punch in and use seal pick to lift snap ring out.

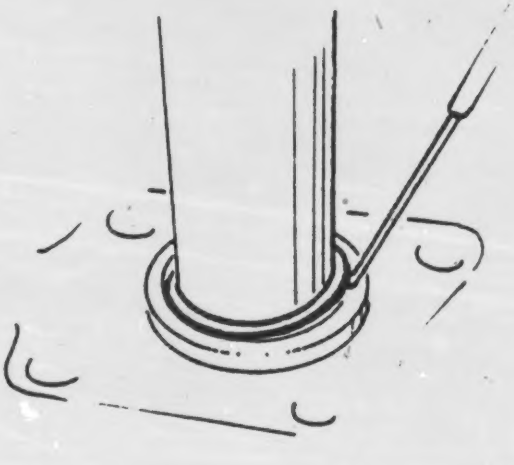


JOB STEPS

8. Push down on retainer ring with small screwdriver and force other side of ring up and remove retainer ring.



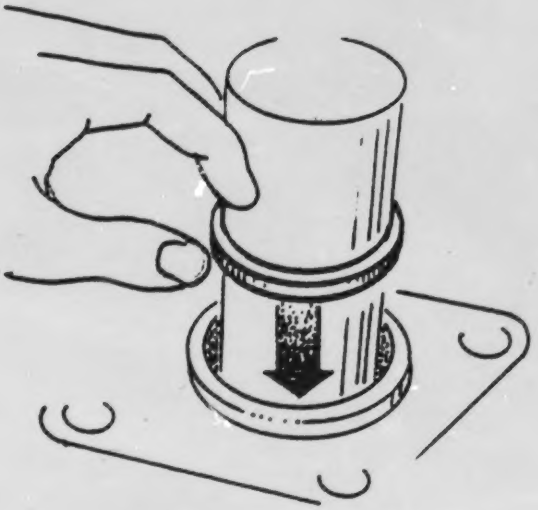
9. Using seal pick, pull seal out of housing, being careful not to scratch crankshaft as new seal could be damaged when installing over a damaged crankshaft.



JOB STEPS

THINK SAFETY - WORK SAFELY

10. Install new seal being sure seal is installed in correct direction.



11. Using small screwdriver, push seal down all the way.

12. Install retainer ring and push all the way down.

13. Install snap ring. Be sure it goes all the way into groove.

14. Fill with fuel and oil mix.

15. Start and adjust.

16. Check for oil leak.

small engine repair

unit: Small Engine

capital area career center

module: 7501 01 017 date: 5-13-77 level: I

skill title: How to Check Crankshaft End Play

developed & written by: Don Foster and Dwight Smith

visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

You are going to learn:

How to check the end play of an engine crankshaft.

And in order to do this you will need:

a two or four cycle engine

Briggs and Stratton Repair Manual IV

Dial indicator kit

Tools

We will know that you can do it when:

You have measured the end play of a crankshaft and told your instructor what it is.

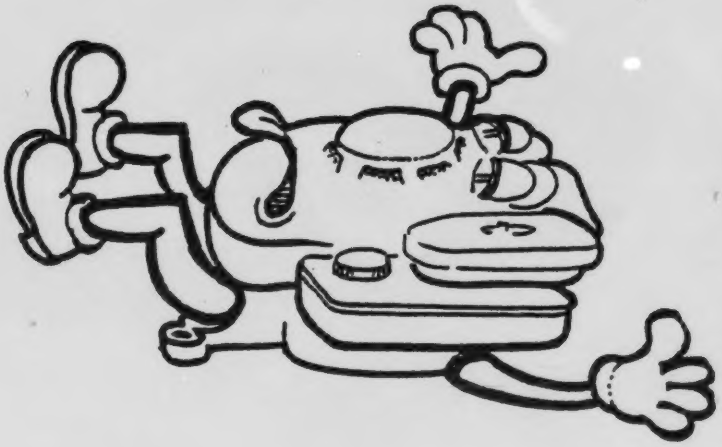
INFORMATION

What is crankshaft end play?

Crankshaft end play is the clearance between the block and sump and the crankshaft-throws.

Get the cutaway Briggs and Stratton engine display III. If you push up on the bottom end of the crankshaft (the Power Take Off end or PTO) and then pull down on it, you'll see that the movement is crankshaft end play. Show your instructor where this end play is on the display engine.

Engine's need end play to help lower friction between the block and sump and the crankshaft. If there is not enough end play, the engine will seize up and die.



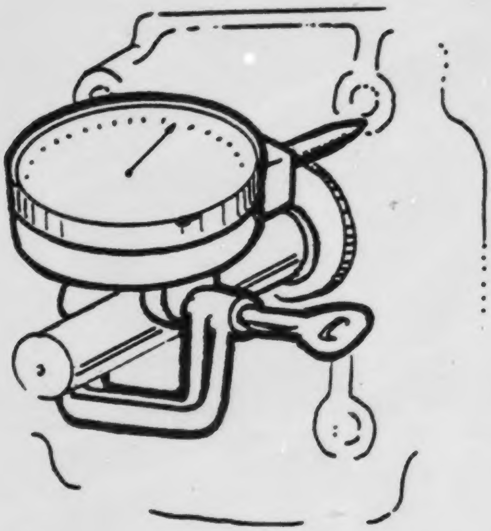
JOB STEPS

1. Get display number III and take it to the work area.

DISPLAY No. 3
THIS END UP

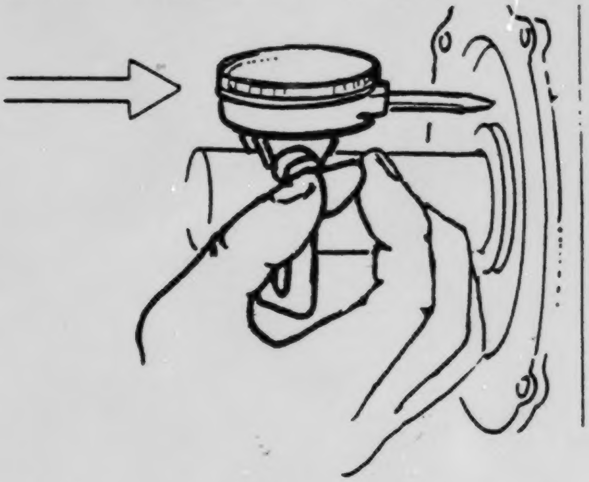
2. Get the end play gauge kit from the tool crib.

3. Put the end play gauge kit on the PTO end of the crankshaft. Check to be sure you put it on so that the dial indicator looks like the drawing below.



JOB STEPS

4. Tighten the dial indicator onto the crankshaft and push it toward the block. Do this until the needle on the dial moves a few thousandths of an inch. Finish tightening the clamp.

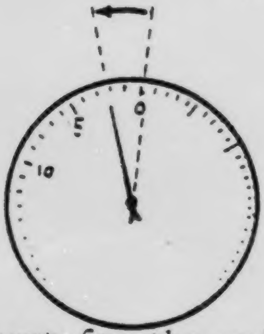


5. Push the crankshaft all the way towards the Mag side of the engine.

6. Turn the dial on the dial indicator until it reads "0" (zero). This is called "zeroing" the dial indicator.

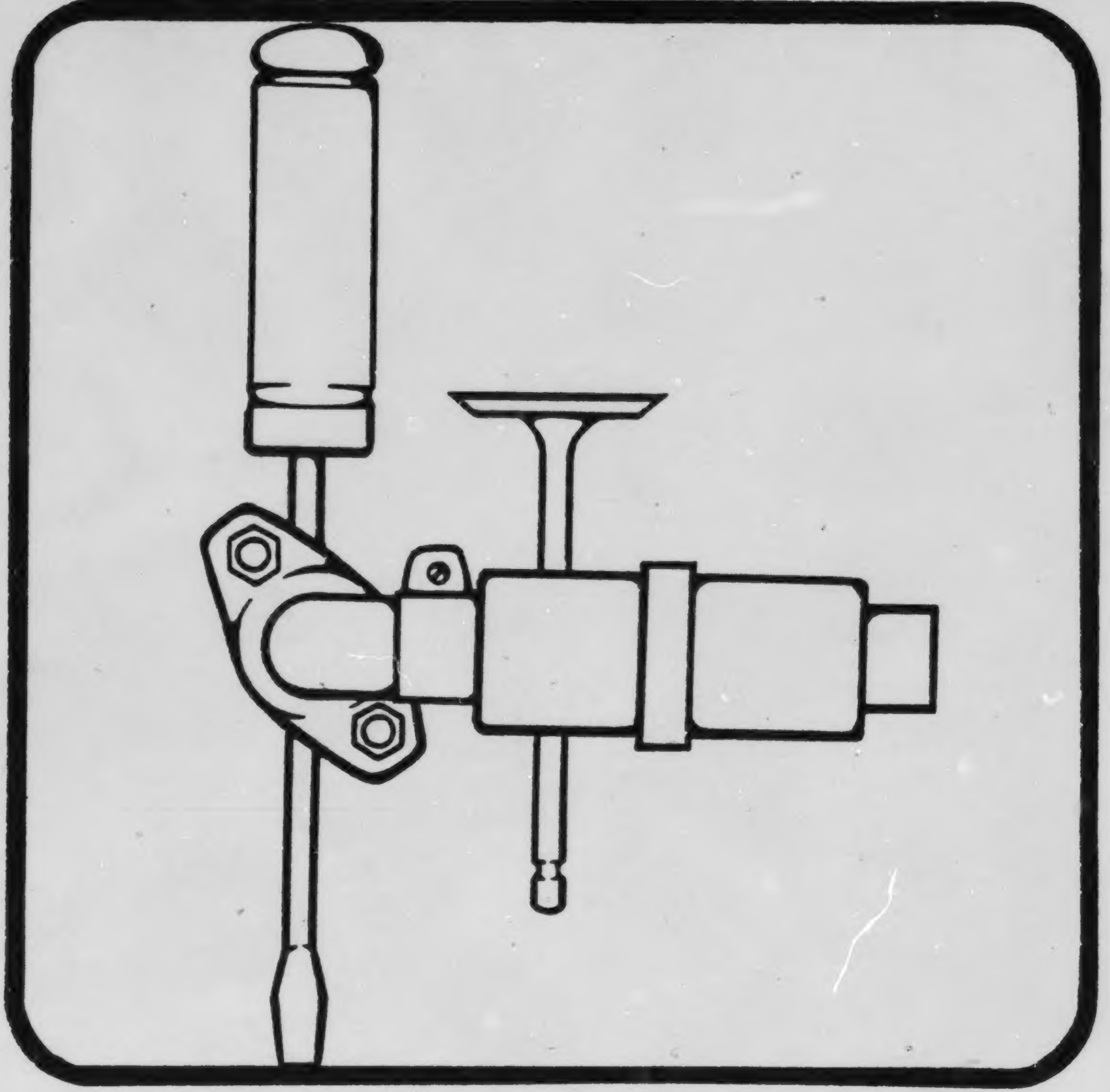
7. Push the crankshaft all the way towards the PTO side of the engine.

8. Count how many thousandths of an inch the needle has moved. (.001 equals one thousandth) This is the amount of end play.



9. Check the manual or chart for the end play specifications for your engine.

10. Put away all equipment.



small engine repair

unit: ENGINE BLOCK

capital area career center

module: 7501 01 021 date: March 1978 level: I

skill title: Remove and Replace Crankshaft

developed & written by: Don Foster

visuals by: Bruce Bennett

PERFORMANCE OBJECTIVE:

YOU ARE GOING TO LEARN:

How to remove and replace the crankshaft on a Briggs and Stratton 92000 series engine.

AND IN ORDER TO DO THIS YOU WILL NEED:

A Briggs and Stratton 92000 series engine

Hand tools

WE WILL KNOW YOU CAN DO IT WHEN:

You have removed and replaced the crankshaft so well that the crankshaft turns smoothly and all parts are in working order.

JOB STEPS

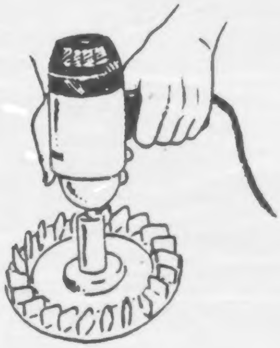
1. Take your equipment to your work area.

2. Drain the gas and oil.

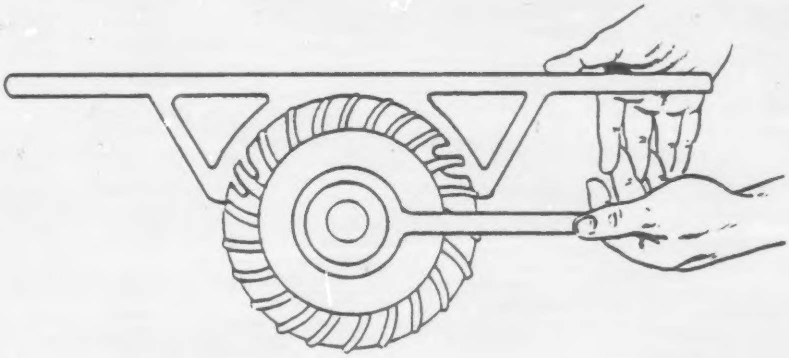
3. Remove the starter assembly if it is a side mount starter.

4. Then remove the air housing. Some engines have the starter in the air housing

5. Remove the flywheel nut using the electric impact wrench;



Or, if the flywheel is held on with a starter clutch, you will have to remove it using the clutch wrench and flywheel holder.

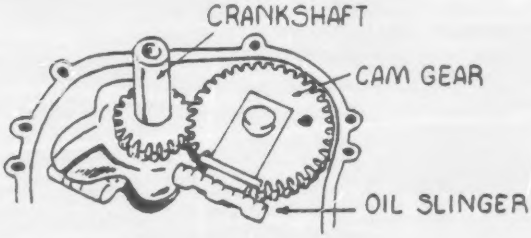


JOB STEPS

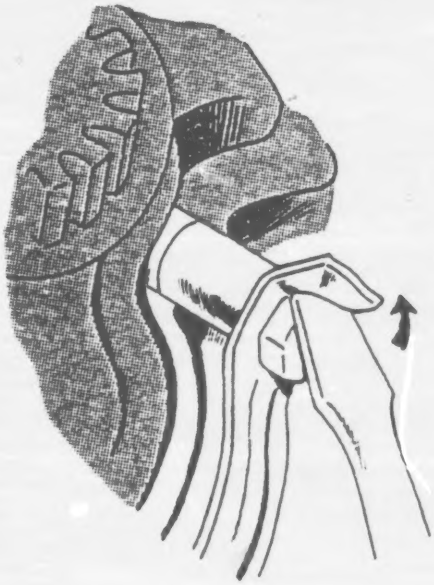
6. Remove the flywheel using a flywheel knocker or Briggs and Stratton puller (knocker is faster).

7. Remove the sump (remember mod 7501 01 001).

8. Remove the oil slinger and camshaft.

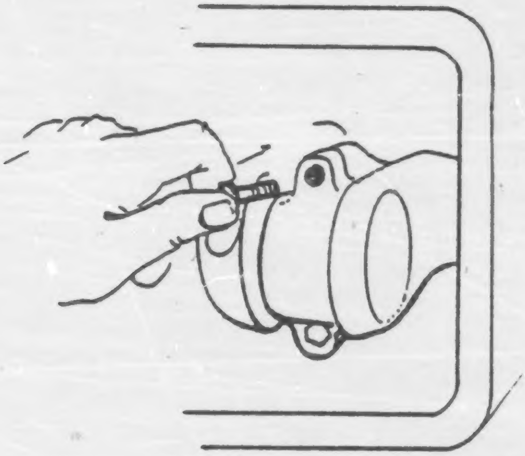

CRANKSHAFT
CAM GEAR
OIL SLINGER

9. Bend back the rod bolt locks.



JOB STEPS

10. Remove the rod bolts.

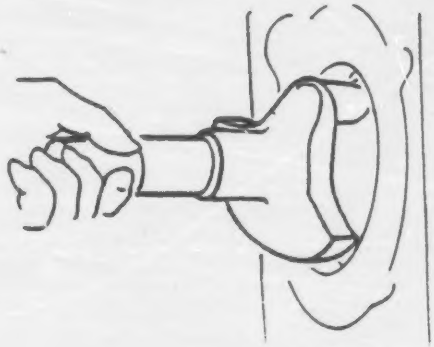


11. Remove the rod cap.

12. Rotate the crankshaft and piston to top dead center.

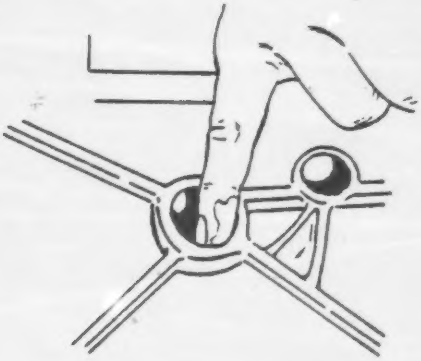
13. Turn block so that the rod lays down against the block.

14. Turn the crankshaft and gently pull the crankshaft out of the engine.



JOB STEPS

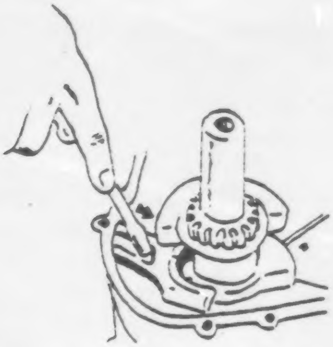
15. Clean the new crankshaft so that it can be installed. Put grease or oil on the mag side main bearing.



16. Align the crankshaft as in the illustration for step 14 and install the crankshaft in the block.

17. Put oil or grease on the rod bearing journal.

18. Put a screwdriver against the block and hook it in the rod and pry the rod down to the crankshaft.



JOB STEPS

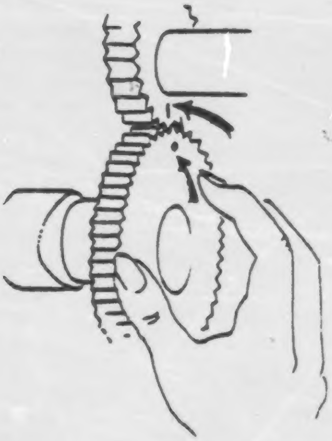
19. Install the rod cap, be sure it is on right.

20. Tighten and torque the rod bolts.

21. Bend the rod bolt locks against the head of the bolt. Have the instructor OK it before the next step.

22. Rotate the crankshaft so that the mark on the crank gear lines up with the camshaft.

23. Install the camshaft with the timing mark toward the timing mark on the crankshaft.



24. Install the oil slinger on the camshaft.

25. Remove the oil seal from the sump.

26. Oil or grease the sump main bearing and the camshaft bearing.

27. Install the sump on the block and tighten two screws to 65 inch pounds.

28. Check the end play and adjust if needed (remember mod 7501 01 017).

JOB STEPS

29. Install the rest of the sump bolts and torque.

30. Install the oil seal in the sump.

31. Turn the block over, then clean and gap the points.

32. Install the point cover and flywheel and torque it.

33. Install the air housing.

34. Install the starter.

35. Fill the engine with oil and some gas.

36. Bolt the engine down on the bench or mower deck.

37. Start and adjust and have the instructor check your work.

38. Clean up and return all tools.

small engine repair

unit: Engine Block

capital area career center

module: 7501 01 022 date: 5/77 level: I

skill title: Inspect and Mike Crankshaft

developed & written by: Eric Schwing

visuals by:

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to inspect a crankshaft to find if it is damaged or worn and to measure the JOURNALS to see if they are worn.

IN ORDER TO DO THIS YOU WILL NEED:

A crankshaft from a small engine

A micrometer

The repair manual for the engine that the crankshaft came from

Slide/tape for module 7501 01 022

WE WILL KNOW YOU CAN DO IT WHEN:

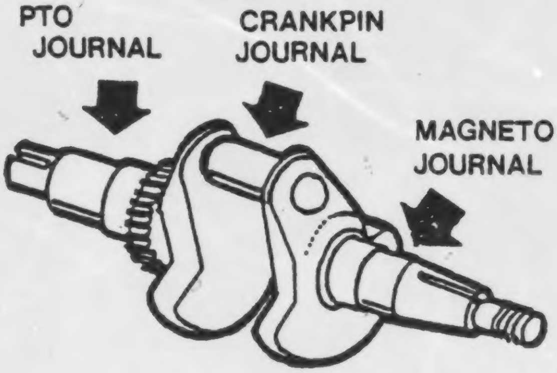
You can measure the crankshaft journals to check specifications and can show damaged or worn parts to your instructor.

INFORMATION

You will need to know how to use a micrometer (mike). Remember that micrometers are expensive and delicate. Dropping onw could easily ruin it. Be careful!

When you have removed the crankshaft from the engine you will want to check it for wear. First look at the gear teeth. There should be no missing or broken teeth. Look at the keyway plunger and at the threads on the end of the shaft. None of the parts should be damaged.

The illustration shows three areas on the crankshaft where bearings or the connecting rod meet the shaft. These areas are called Journals. Look at the illustration and find the Magneto Journal, the Crankpin Journal, and the Power Take Off (P.T.O.) Journal.



If any of these areas are worn smaller than the sizes in the repair manual specifications, the crankshaft must be replaced. Look at the table on p. 4. It shows the smallest sizes allowed for many types of Briggs and Stratton engines. These sizes are sometimes called Rejection Sizes. Find the rejection size for the power take off journal for an engine with model number 80092. Note that the power take off journal is called the Drive Journal in this table. If you measured the power take off journal on an engine with a serial number of 80092, and it was .9969, could you use the crankshaft? What would you do if you had a crankshaft from a 60000 series engine and the crankpin journal was .8700, the magneto journal was .8733 and the power take off journal was .8699?

COMMON SPECIFICATIONS FOR ALL POPULAR ENGINE MODELS

1. Spark plug gap: .030 All Models
2. Condenser capacity: .18 to .24 MFD. All Models
3. Contact point gap: .020 All Models
4. Top governed speed: See Briggs & Stratton Service Bulletin No. 467
5. Crankshaft End Play: .002-.008 All Models

	BASIC MODEL SERIES	IDLE SPEED	ARMATURE TWO LEG AIR GAP	ARMATURE THREE LEG AIR GAP	VALVE CLEARANCE INTAKE	VALVE CLEARANCE EXHAUST	VALVE GUIDE REJECT GAGE	TORQUE SPECIFICATIONS FLYWHEEL NUT FT. LBS.	TORQUE SPECIFICATIONS CYLINDER HEAD IN. LBS.	TORQUE SPECIFICATIONS CONN. ROD IN. LBS.
ALUMINUM	6B, 60000	1750	.006 .010	.012 .016	.005 .007	.009 .011	19122	55	140	100
	8B, 80000, 82000	1750	.006 .010	.012 .016	.005 .007	.009 .011	19122	55	140	100
	92000	1750	.006 .010		.005 .007	.009 .011	19122	55	140	100
	100000	1750	.010 .014	.012 .016	.005 .007	.009 .011	19122	60	140	100
	110000	1750	.006 .010		.005 .007	.009 .011	19122	55	140	100
	130000	1750	.010 .014		.005 .007	.009 .011	19122	60	140	100
	140000	1750	.010 .014	.016 .019	.005 .007	.009 .011	19151	65	165	165
	170000, 171700•	1750 **	.010 .014		.005 .007	.009 .011	19151	65	165	165
	190000, 191700•	1750 **	.010 .014		.005 .007	.009 .011	19151	65	165	165
	251000	1750	.010 .014		.005 .007	.009 .011	19151	65	165	190
CAST IRON	5, 6, N	1750		.012 .016	.007 .009	.014 .016	19122	55	140	100
	8	1750		.012 .016	.007 .009	.014 .016	19122	55	140	100
	9	1200			.007 .009	.014 .016	19151	60	140	140
	14	1200			.007 .009	.014 .016	19151	65	165	190
	19, 190000, 200000•	1200 **	.010 .014	.022 .026	.007 .009	.014 .016	19151	115	190	190
	23, 230000	1200 **	.010 .014	.022 .026	.007 .009	.017 .019	19151	145	190	190
	243000	1200 **	.010 .014		.007 .009	.017 .019	19151	145	190	190
	300000	1200 **	.010 .014		.007 .009	.017 .019	19151	145	190	190
	320000	1200 **	.010 .014		.007 .009	.017 .019	19151	145	190	190

CRANKSHAFT REJECT SIZE MAG. JOURNAL	CRANKSHAFT REJECT SIZE CRANKPIN	CRANKSHAFT REJECT SIZE P.T.O. JOURNAL	MAIN BEARING REJECT GAGE	CYLINDER BORE STD. ▲
.8726	.8697	.8726	19166	2.375* 2.374
.8726	.9963	.8726	19166	2.375 2.374
.8726	.9963	.8726	19166	2.5625 2.5615
.8726	.9963	.9976	19166 Mag. 19178 PTO	2.500 2.499
.8726	.9963	.8726	19166	2.7812 2.7802
.8726	.9963	.9976	19166 Mag. 19178 PTO	2.5625 2.5615
.9975	1.090	1.1790	19178	2.750 2.749
.9975 1.1790•	1.090	1.1790	19178	3.000 2.999
.9975 1.1790•	1.122	1.1790	19178	3.000 2.999
1.3760	1.2470	1.3760		3.4375 3.4365
.8726	.7433	.8726	19166	2.000 1.999
.8726	.7433	.8726	19166	2.250 2.249
.9832	.8726	.9832	19117	2.250 2.249
1.1790	.9964	1.1790	19117	2.625 2.624
1.1800	.9964 1.1219•	1.1790	19117	3.000 2.999
1.3769	1.1844	1.3759	19117	3.000 2.999
Ball	1.3094	Ball	Ball	3.0625 3.0615
Ball	1.3094	Ball	Ball	3.4375 3.4365
Ball	1.3094	Ball	Ball	3.5625 3.5615

INITIAL CARBURETOR ADJUSTMENT ALL MODELS

CARBURETOR TYPE	TURNS OPEN FROM SEAT NEEDLE VALVE	TURNS OPEN FROM SEAT IDLE VALVE
Pulsa-Jet Vacu-Jet	1-1/2	
Two Piece Flo-Jet	1-1/2	3/4
One Piece Flo-Jet	2-1/2	1-1/2
One Piece Flo-Jet (6, 7 & 8 H.P.)	1-1/8	1-1/8

CYLINDER RESIZING

▲ Resize if .003 or more wear or .0015 out of round on C.I. cylinder engines, .0025 out of round on aluminum alloy engines.

Resize to .010, .020 or .030 over Standard.

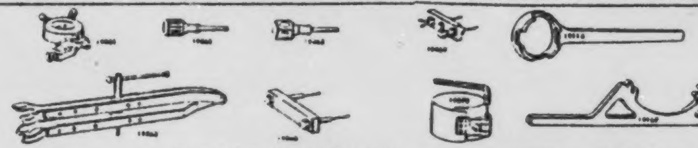
* Model 6B series and early Models 60000 and 61000 series engines have cylinder diameter of 2.3125 – 2.3115.

RING GAP REJECT SIZES

MODEL	COMP. RINGS	OIL RING
Alum. Cylinder Models	.035"	.045"
C.I. Cylinder Models	.030"	.035"

** GOVERNED IDLE
See Repair Instructions Manual MS-4750

19051	Spark Tester, all models
19061	Carburetor jet screwdriver, all models
19062	Carburetor jet screwdriver, all models
19063	Valve spring compressor, all models
19068	Fly-wheel Puller, cast iron models



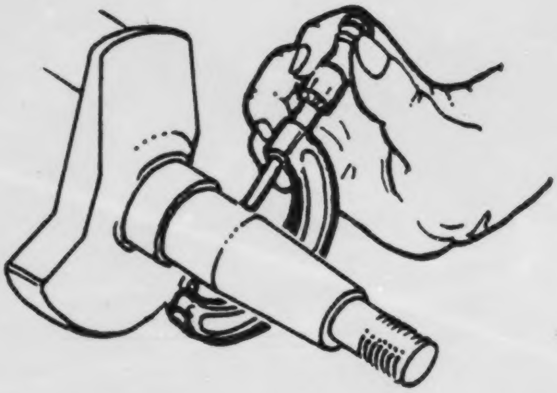
Flywheel puller, all models thru 130000	19069
Piston ring compressor, all models	19070
Starter clutch wrench, all rewind starter models	19114
Flywheel puller 140000, 170000, 190000, 251000 models	19165
Flywheel holder, all models thru 130000	19167

COMMONLY USED TOOLS FOR SERVICING BRIGGS & STRATTON ENGINES   See Section 13 for Complete List of Tools

JOB STEPS

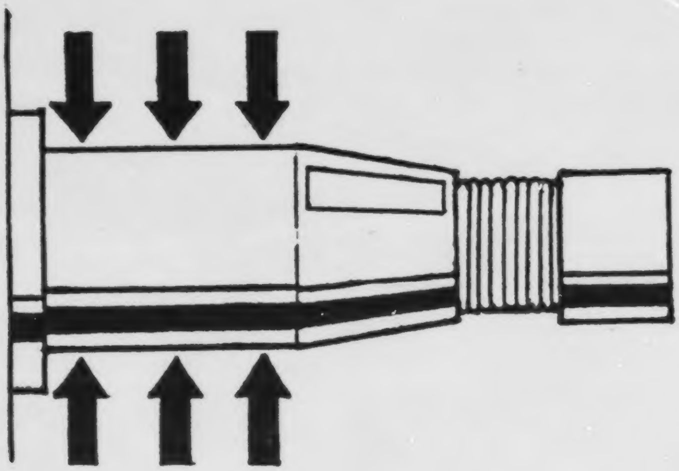
1. Look in the service manual for the engine you are working on and find the table of rejection sizes for the crankshaft. There is also a table of rejection sizes for the camshaft, so be sure that you are using the right table.

2. Measure the magneto journal several times with the micrometer. Try to find the smallest place on the journal, and write all the measurements down.



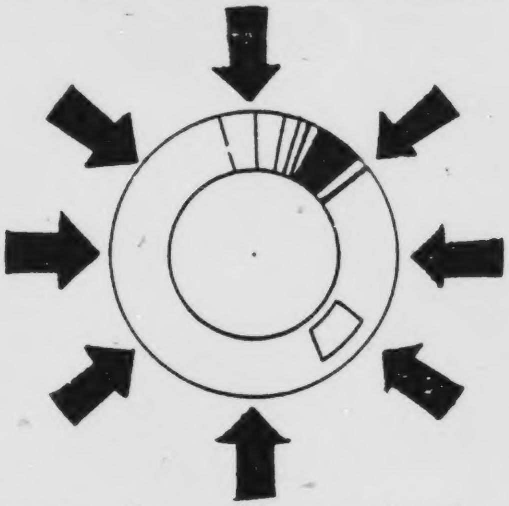
3. Check the smallest number you have written with the rejection size given in the table of the service manual for your engine.

4. Check to see that measurements are nearly all the same. If one place measures smaller than the others, the crankshaft may have a taper worn in it.



JOB STEPS

5. Also check for out-of-round by making sure the journal measures the same all around. (See illustration below.)



If measurements are not close all around, the journal is out-of-round.

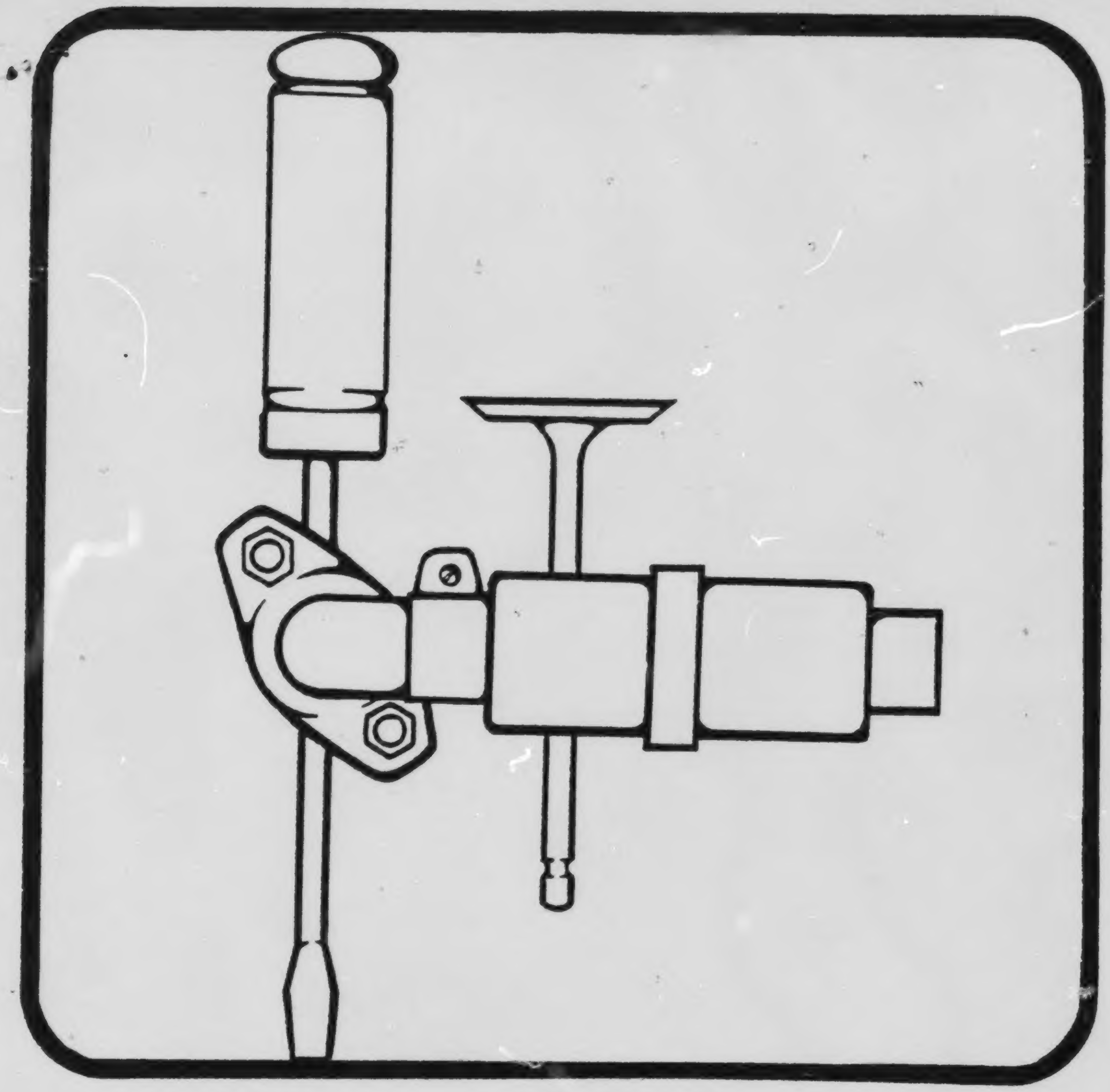
6. Now measure the Crankpin Journal in the same way.

7. Check the service manual for crankpin journal rejection sizes.

8. Then check for out-of-round on the crankpin journal.

9. Now do steps 6, 7 and 8 on the P.T.O. journal.

10. Did your crankshaft pass? Tell your instructor your measurements for each journal, and whether the crankshaft can be used.



small engine repair

unit: ENGINE BLOCK

capital area career center

module: 7501 01 023 date: May 1977 level: I

skill title: Replacing Crankshaft on a 2 or 4 Cycle Engine

developed & written by: Eric Schwing

visuals by:

PERFORMANCE OBJECTIVE

You are going to learn:

How to replace the crankshaft in a small engine and check and adjust the end play.

And in order to do this you will need:

A small 2 or 4 cycle engine.

A set of crankcase cover gaskets.

A dial indicator.

A socket wrench set.

If the engine has ball bearings, you will also need:

A hammer.

A long punch.

Some sealer.

We will know you can do this when:

You can replace the crankshaft in a small engine so that when the engine is re-assembled it will run smoothly and according to specifications.

INFORMATION

The directions in this mod apply to several types of small engines. Before you begin, be sure that you have read the repair instructions for the engine that you have. Try to find any differences in the mod and repair manual. Get your instructor to help if you have any questions. Remember to be careful with the engine parts, and especially careful with the delicate measuring tools you will be using.

You may need to know how to replace the ball bearings on a crankshaft. Look in the repair manual. You will also have to know how to replace the tappets in the engine you are working on. See module 7501 01 004. The tappets must be in before you replace the crankshaft.

Be sure you have studied these modules and watched the slide tapes:

7501 01 017 - Check Crankshaft End Play.

7501 01 022 - Inspect and Mike Crankshaft.

JOB STEPS

ALUMINUM ENGINES

You will need:

A set of cover gaskets for the engine you have.

A socket wrench set.

A dial indicator to check the end play.

ALUMINUM ENGINES WITH PLAIN BEARINGS

1. Put some oil on the crankshaft journals and put the crank into the engine from the power take off side. The magneto end of the shaft should go in first.

2. Put the cam gear in. You will see timing marks on both the crank and cam gear. Line the marks up when you put the cam gear in. Turn the crank and cam gear until the two marks are together.

3. Put on the .015 gasket, then put on the cover. Tighten the bolts so that you can check the end play.

ALUMINUM ENGINES WITH BALL BEARINGS

1. If the aluminum engine you have has ball bearings on the power take off side, you will see the timing mark on the crankshaft counterweight. The crankshaft and cam gear must be put in together with the timing marks lined up.

2. Hold the crankshaft so that the crankpin will be up near the center of the cylinder as it goes in.

3. Hold the cam gear against the crank gear with the timing marks lined up.

4. Put the crankshaft and cam gear into the engine from the power take off side. Put on a .015 gasket, replace the cover, and tighten the bolts. Now you are ready to check the end play.

JOB STEPS

CHECKING THE END PLAY - ALUMINUM ENGINES WITH PLAIN BEARINGS

4. Push the shaft into the engine as far as it will go and clamp the dial indicator to the shaft.

5. With the shaft in all the way, turn the dial on the indicator until it reads zero.

6. Pull the shaft out all the way. The indicator will show how much the shaft has moved. Try this several times. The shaft should move more than .002, but less than .008.

7. If the end play is less than .002, take the cover off and remove the .015 gasket. If more than .008, go to step 9. Put a thinner gasket in. You may have to use more than one of the thinner gaskets to get the proper end play.

8. Tighten the cover back on and measure the end play again. Keep trying until the shaft moves more than .002, but less than .008.

9. If the shaft moves more than .008 with the .015 gasket in, you will need a thrust washer. Take the cover off and put the washer on over the end of the shaft. Slide the washer on until it is tight against the gear.

10. Put the cover back on and tighten it. Measure the end play again. You may have to take off the .015 gasket and replace it with a thinner one to get the proper end play.

CHECKING THE END PLAY - ALUMINUM ENGINES WITH BALL BEARINGS

If your aluminum engine has ball bearings on the power take off side, you can follow the same directions for aluminum engines with plain bearings. There is only one difference. If the end play you measure with the .015 gasket on is more than .008 and you have to use the thrust washer, the washer goes on the magneto end of the shaft.

JOB STEPS

CAST IRON ENGINES

If you are ready to replace the camshaft in a cast iron engine, you will have to know if the engine has plain bearings or ball bearings on the power take off side. Read the manual for your machine before you begin.

You will need:

A hammer.

Sealer for the camshaft plug.

A long punch to drive the camshaft back in.

A set of gaskets for the crankcase cover.

A dial indicator to check the end play.

PLAIN BEARING ENGINES

1. If your cast iron engine has plain bearings on the power take off side of the crankshaft, you replace the crankshaft by first reaching in and holding the cam gear.

2. Push the camshaft into the camshaft hole on the magneto side.

3. Use the punch to carefully hammer the shaft through the cam gear and into the hole on the power take off side. Stop when the shaft is just even with the outside of the cylinder on the power take off side.

4. Put a small amount of sealer on the camshaft plug and push or hammer it carefully into the hole on the magneto side.

5. hold the crankshaft so that the crankpin will be up near the cylinder.

6. Find the timing marks on the cam gear and on the crank gear.

7. Put the crankshaft into the power take off side, making sure that the timing marks are lined up.

8. With the .015 gasket in place, put the cover back on and tighten the bolts. You are now ready to check the end play.

JOB STEPS

BALL BEARING ENGINES

1. If your cast iron engine has ball bearings on the power take off end of the crankshaft, replace the crankshaft by reaching in and holding the cam gear in the space in the front of the engine, out of the way of the crankshaft.

2. While holding the cam gear, put the crankshaft into the engine from the magneto side.

3. Line up the timing marks on the cam gear and on the crankshaft counterweight.

4. Push the cam gear back until the gears are together.

5. Keep holding the gears in place and put the camshaft back into the engine from the magneto side. Use the punch to carefully hammer the shaft until it is even with the cylinder on the power take off side.

6. Put a small amount of sealer on the camshaft plug and press or gently hammer it back into place on the magneto end of the camshaft. Now you can replace the crankcase cover with the .015 gasket and check the end play.

CHECKING END PLAY - CAST IRON ENGINES

1. when the crankcase cover is tightened on with the .015 gasket in place, clamp the dial indicator to the power take off end of the crankshaft.

2. Push the shaft into the engine as far as it will go.

3. Turn the dial on the indicator until the needle points to zero.

4. Pull the shaft back out as far as it will go. The indicator should read between .002 and .008.

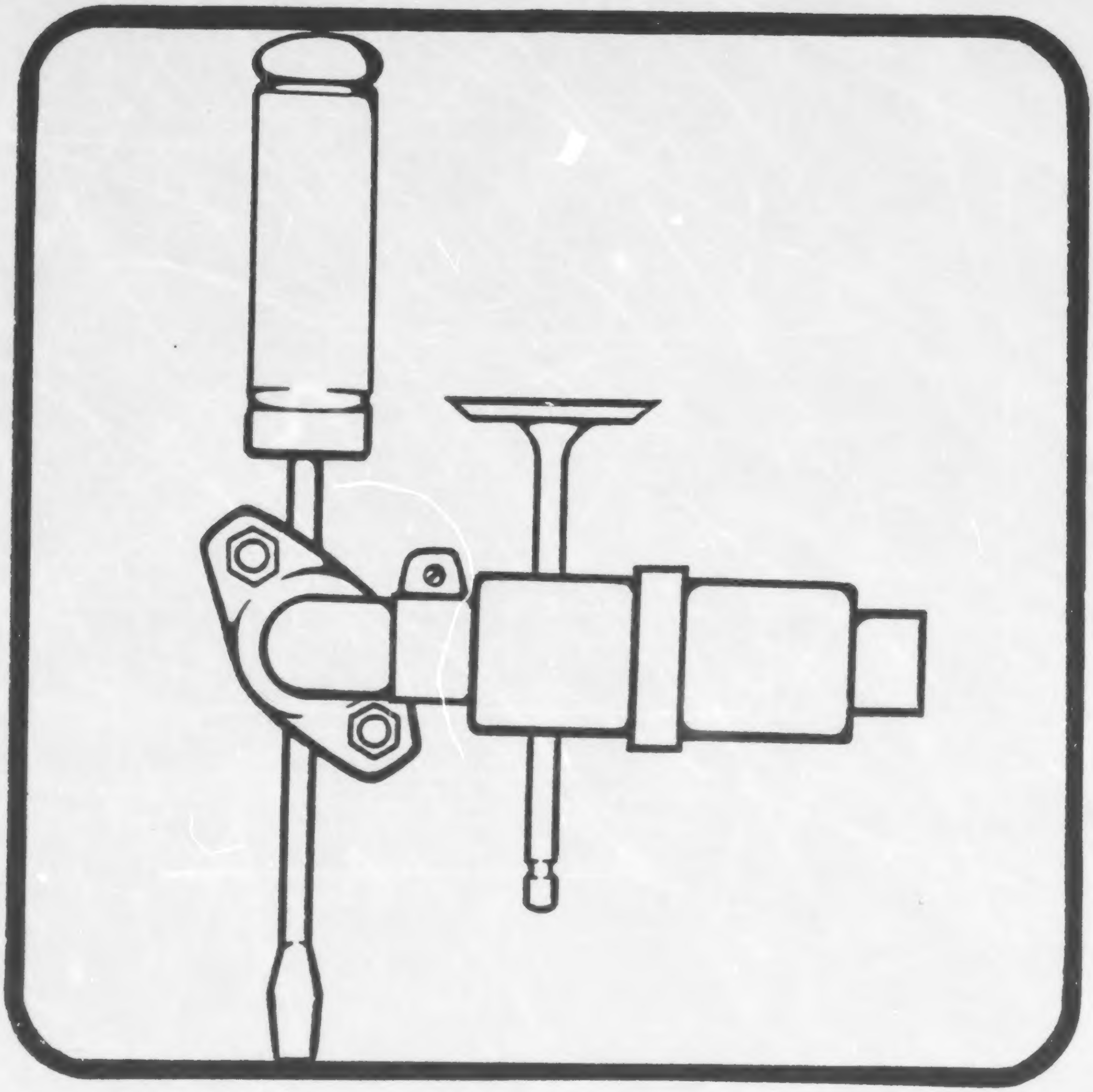
5. If the end play is more than .008, take the cover off and add one or more of the thinner (.005 or .009) gaskets. If the dial indicator reads less than .002 end play, go to step 8.

JOB STEPS

6. Replace the cover and tighten the bolts.

7. Check the end play again. Keep trying until the indicator reads between .002 and .008.

8. If dial reads less then .002 end play, remove the cover and replace the .015 gasket with one or both of the thinner gaskets until you read within .002 and .008.



small engine repair

unit: ENGINE BLOCK

capital area career center

module: 7501 01 024 date: January 1978 level: I

skill title: Check Oil Pump

developed & written by: Jim Pitts

visuals by: Bruce Bennett

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to check the oil pump to see if the gear teeth are chipped and if the pump works.

AND IN ORDER TO DO THIS YOU WILL NEED:

An engine with oil pump

Hand tools

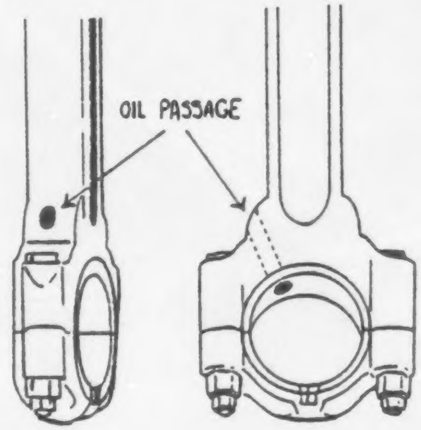
WE WILL KNOW YOU CAN DO IT WHEN:

You have checked an oil pump to see if the gear teeth are chipped and in good working order.

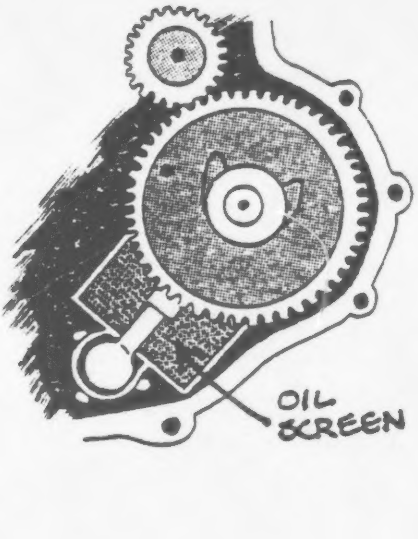
INFORMATION

Engines that have oil pumps have positive displacement lubrication systems. This means the oil pump forces oil through the engine.

Holes drilled through the connecting rod, bearing and piston pin let the oil flow for lubrication.

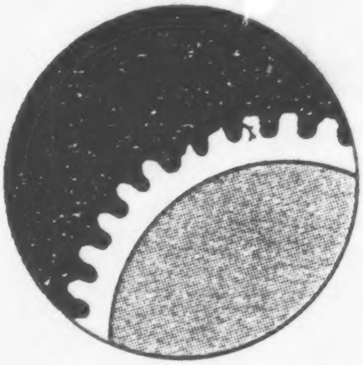


The oil is sucked through a pickup screen in the sump. It is then forced through the engine.

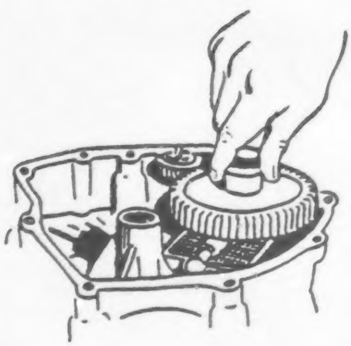


JOB STEPS

1. Get an engine with an oil pump lubrication system.
2. Remove the sump. See module 7501 01 001.
3. Make a list of any new parts you will need to put the engine back together.
4. Find the teeth on the gears in the pump.
5. See if any of the teeth are chipped or broken. If they are, see the instructor about getting new gears.



6. Turn the gears over to see that they mesh.
7. If you can, put some oil in the sump and turn the gears by hand. See if oil is pumped through the engine.

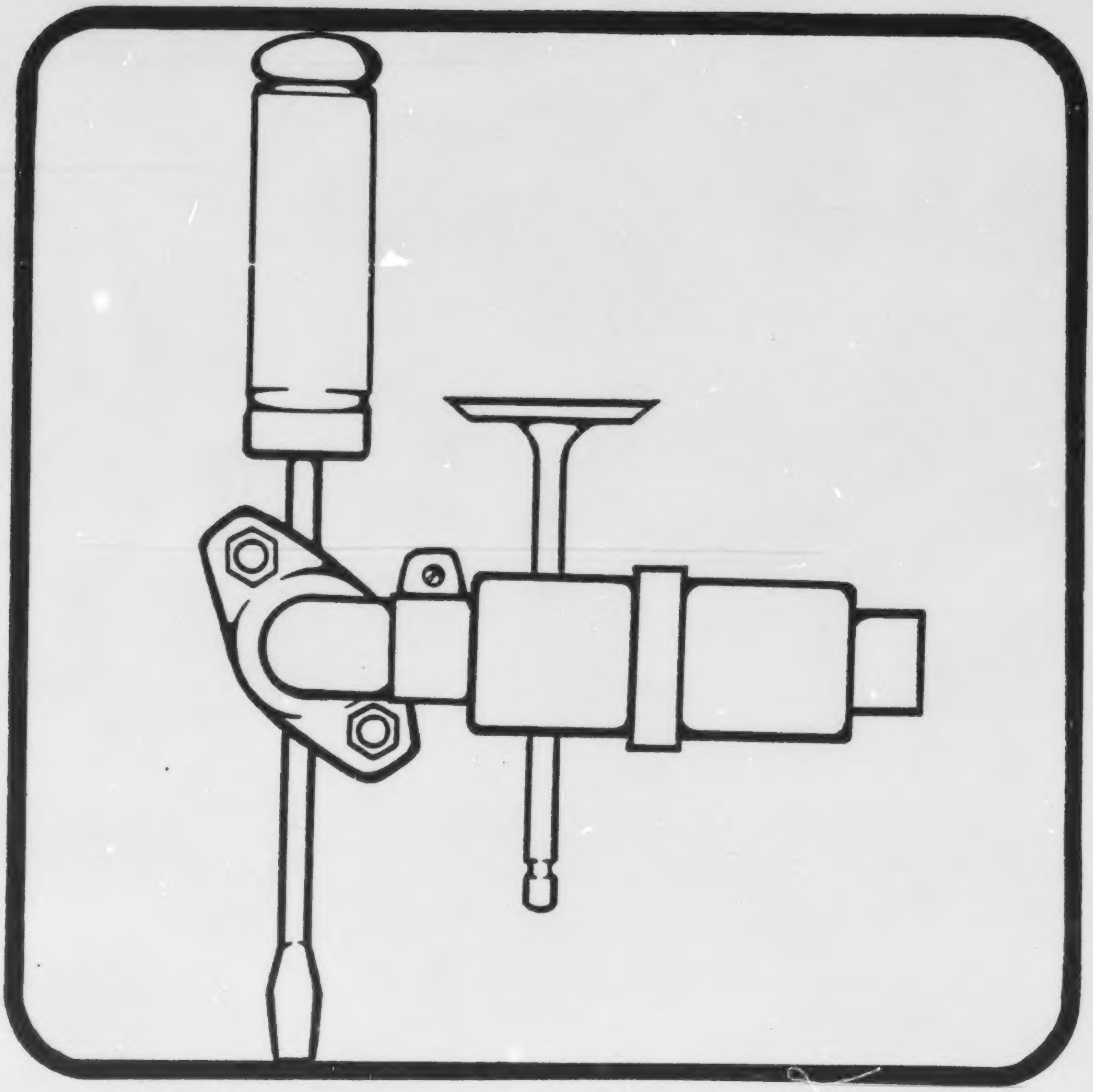


JOB STEPS

8. If gears or pump need to be replaced, see your instructor for help.

9. Put the sump back on the engine.

10. Put oil in the engine. Start the engine to be sure it runs.



small engine repair

unit: ENGINE BLOCK

capital area career center

module: 7501 01 025 date: January 1978 level: I

skill title: Check Dipper or Slinger

developed & written by: Jim Pitts

visuals by: Bruce Bennett

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to check the oil dipper and replace if needed.

IN ORDER TO DO THIS YOU WILL NEED:

Engine with oil dipper

Hand tools

Torque wrench

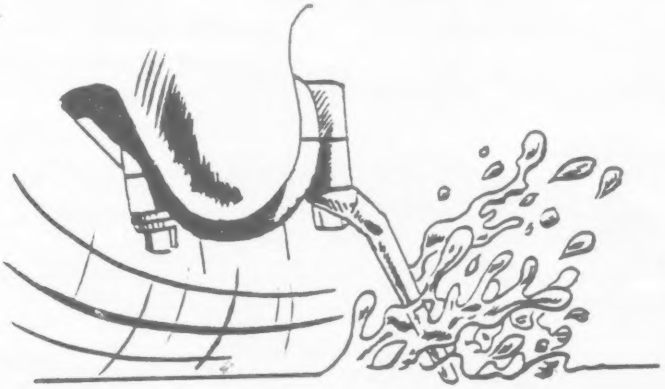
Service manual

WE WILL KNOW YOU CAN DO IT WHEN:

You have checked the oil dipper, replaced it if needed and it works in the right way.

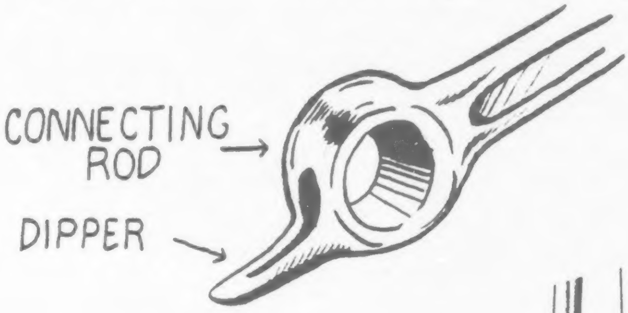
INFORMATION

Small gasoline engines usually use some type of "splash system" to get oil to parts inside the engine. A splash system has a small piece of metal that goes around inside the engine.

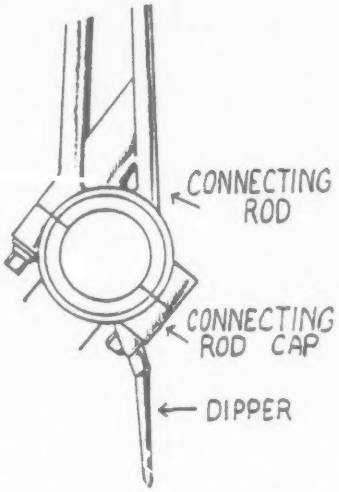


This piece of metal is called a dipper or slinger. It goes through the oil and splashes the oil on the other parts inside the engine.

Some oil dippers are cast on to the connecting rod.


CONNECTING ROD
DIPPER

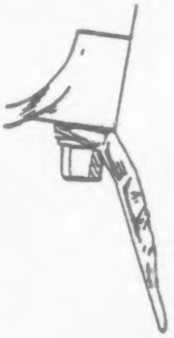
Other dippers are bolted to the cap.


CONNECTING ROD
CONNECTING ROD CAP
DIPPER

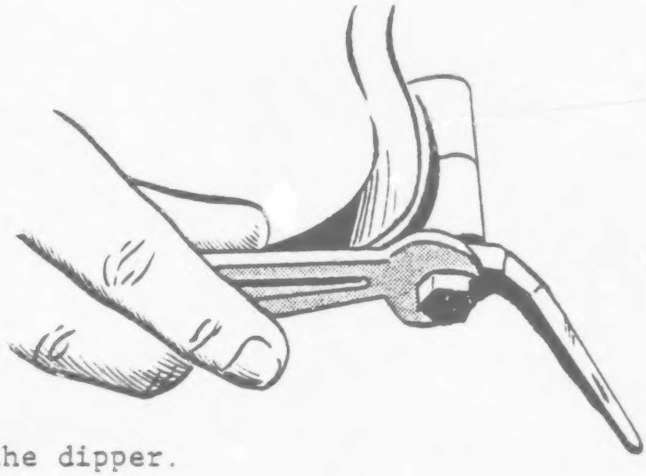
The oil level in the crankcase must be kept full so the dipper can splash in the oil when the crankshaft goes around.

JOB STEPS

1. Get an engine to work on.
2. Remove the sump. Use the steps you learned in mod 7501 01 001 or 7501 01 002.
3. Check the parts for wear, including the oil seal.
4. Make a list of the parts you will need to put the engine back together.
5. Look at the oil dipper to see if it is cracked or chipped. If it is damaged, see the instructor to get a new one. If the dipper is cast to the connecting rod, you will have to get a new connecting rod.



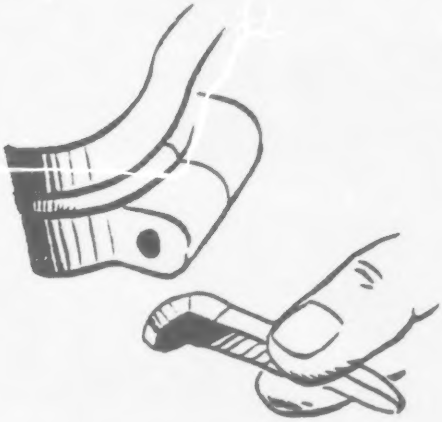
6. If you use a new bolt on dipper, remove the rod bolts.



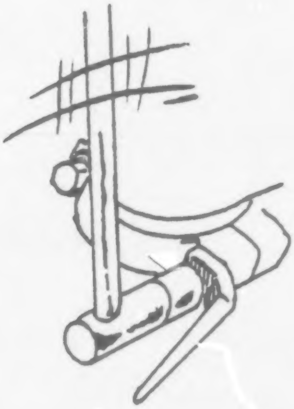
7. Take off the dipper.

JOB STEPS

8. Put the new dipper on the cap, if needed.



9. Torque the rod bolts according to specifications in the service manual.

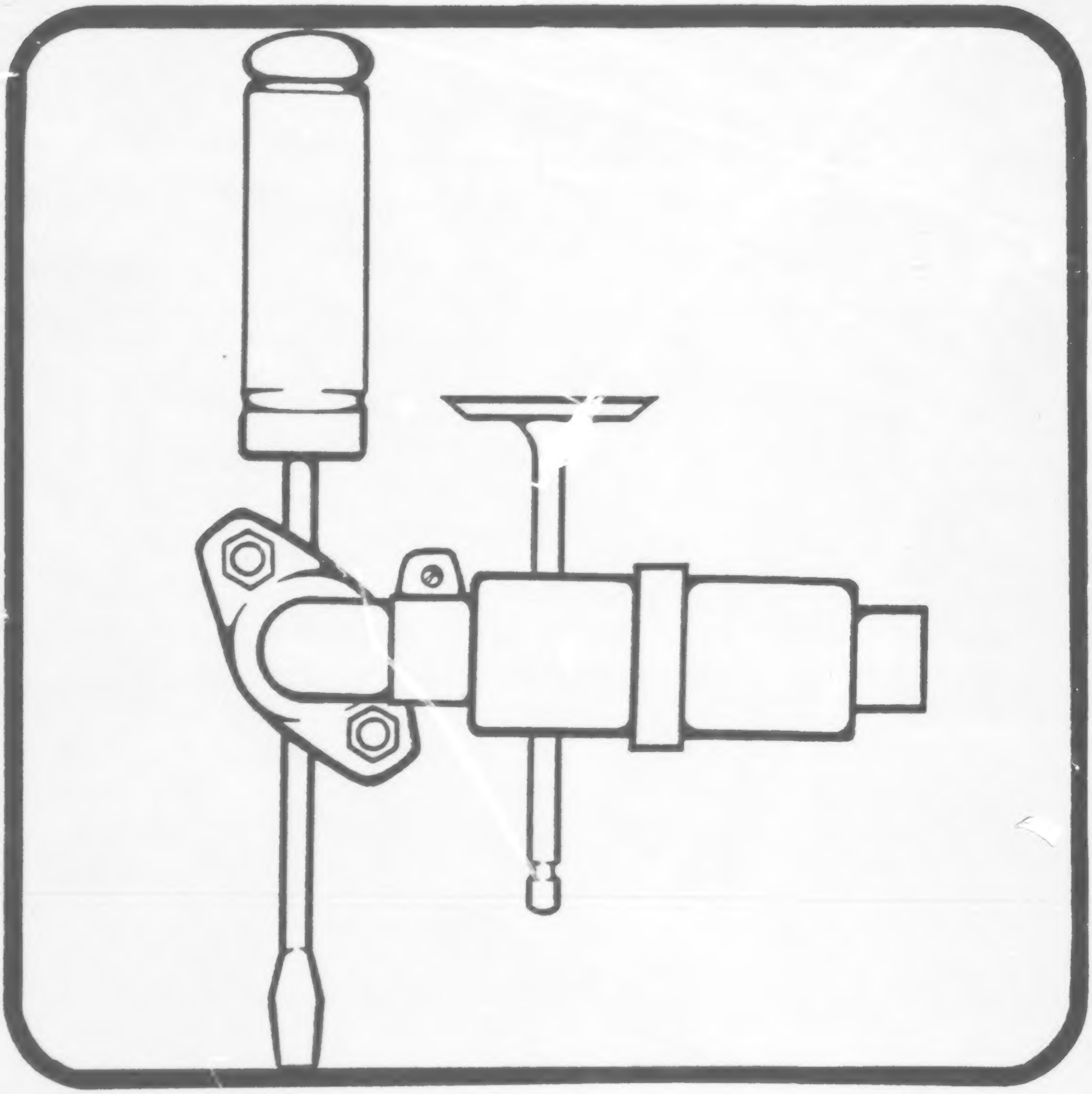


10. Put the sump back on. Include any needed new parts.

11. Put oil in the engine.

12. Start the engine.

13. Have the instructor check your work.



small engine repair

unit: ENGINE BLOCK

capital area career center

module: 7501 01 026 date: May 1977 level: I

skill title: Remove Crankshaft From a 2 or 4 Cycle Engine

developed & written by: Eric Schwing

visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

You are going to learn:

How to remove the crankshaft from a small engine.

And in order to do this you will be given:

- A 2 or 4 cycle engine
- A set of socket wrenches
- A set of screwdrivers
- A rubber mallet
- Safety Glasses
- A long punch
- A file or emery cloth
- Repair instructions for the engine you have

We will know that you can do it when:

You can remove the crankshaft from a small engine without damaging any of the parts, and replace it so that it is set to specifications and turns smoothly when running.

INFORMATION

The directions in this mod apply to several types of small engines. The engine you are working on may be different. Before you begin, make sure that you have read the repair instructions for the engine that you have. Try to find any differences in the repair instructions and the mod. Take your time. Ask questions. When you begin, remember you should never force any parts. Get your instructor to help if you have any trouble.

You must know when the engine has been taken apart enough to allow you to remove the crankshaft. Look in the repair manual and the mods. Ask your instructor if you have any questions.

If the engine you are working on has ball bearings, you must find the directions for removing the magneto. Look in the mod and in the repair instructions.

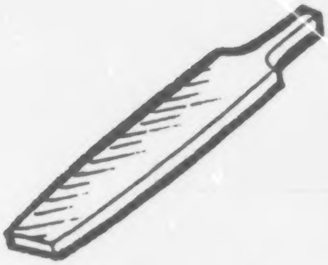
If you are ready to remove the crankshaft, you have to know if you are working with a cast iron or aluminum engine. The method of removing the crankshaft is different for each type of engine. Look at the Job Steps and find the ones that go with the kind of engine you are working on. Read the directions carefully, and make sure that you have all the tools you need before you begin.

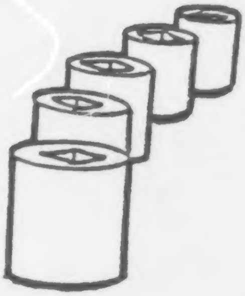
JOB STEPS

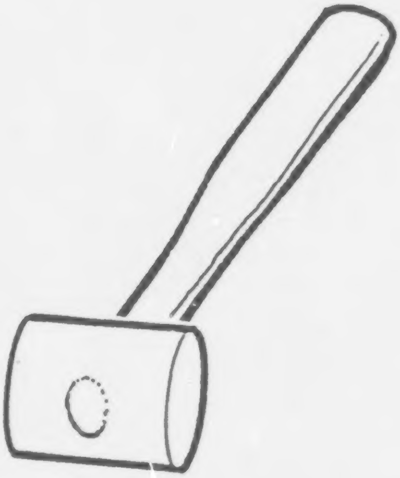
ALUMINUM ENGINES

1. get your equipment. You will need:

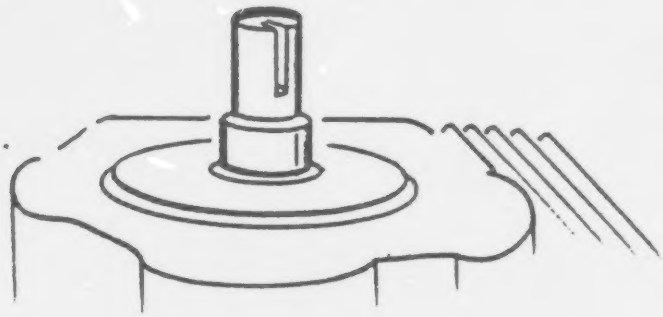
A file or an emery cloth
A socket wrench set
A rubber mallet







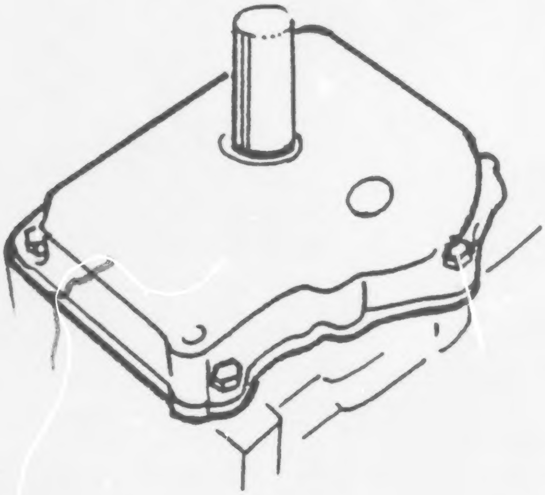
2. Look at the end of the crankshaft sticking out of the engine. This is the POWER TAKE OFF end. Check to see if there is any rust or burrs on this end. If there is, you must remove it with the file or the emery cloth. Make sure the shaft is clean and smooth.



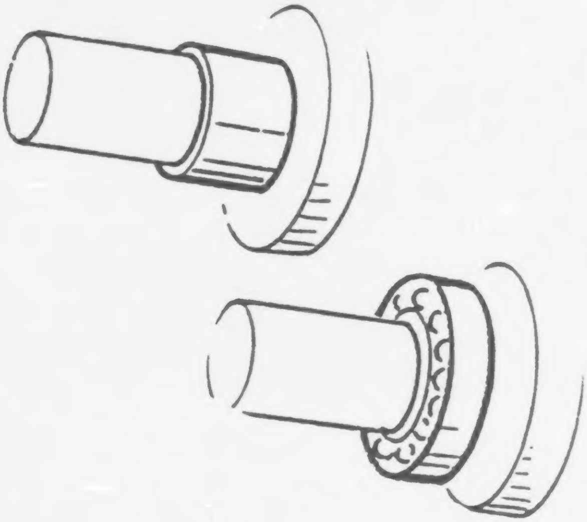
Wear your safety glasses.

JOB STEPS

3. Take off the bolts holding on the crankcase cover. Put them in a safe place. If the cover sticks, you can tap it LIGHTLY with the rubber mallet to loosen the seal. Pull the cover off carefully over the end of the crankshaft.



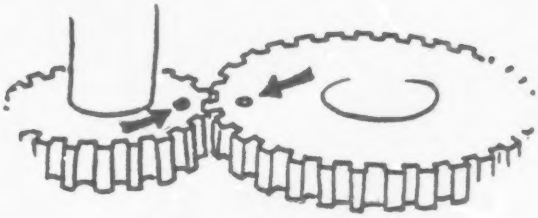
4. Check to see if the engine has plain bearings or ball bearings on the power take off side. Find and follow the set of directions that go with the type of bearings that your engine has.



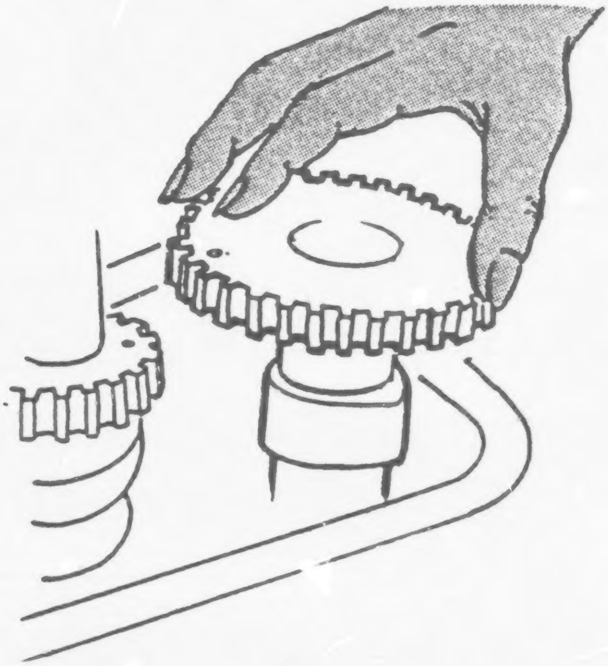
JOB STEPS

PLAIN BEARINGS

5A. Turn the crankshaft until the timing marks on the crankshaft and the cam gear are lined up.



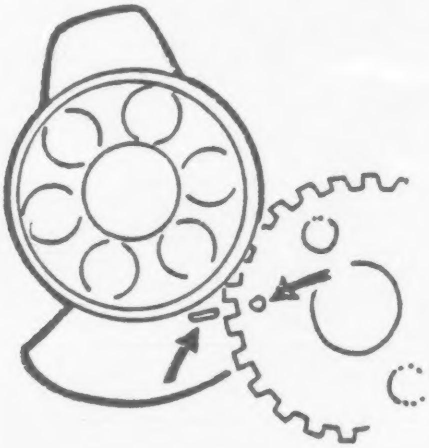
6A. Carefully pull the cam gear out. Now you can carefully pull the crankshaft out.



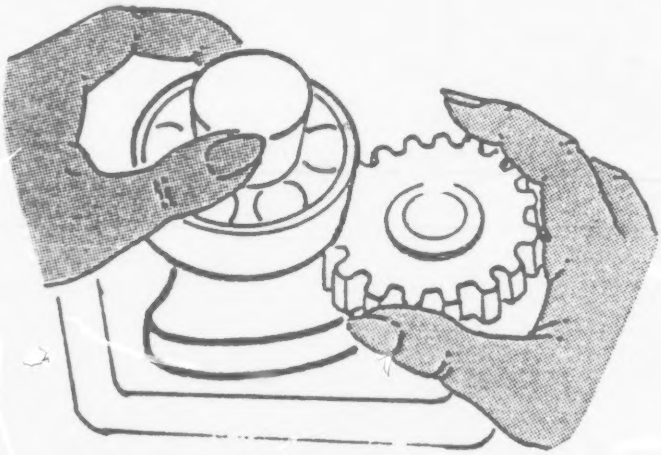
JOB STEPS

BALL BEARINGS

5B. You would not be able to see a timing mark if it was put on the crank gear in an engine with ball bearings. The bearing would be in the way. Find the mark on the crankshaft counterweight.



6B. Turn the crankshaft until the timing marks on the cam gear and counterweight are lined up. You can now pull the cam gear and crankshaft out at the same time. Do this carefully, so that you do not damage the parts.



JOB STEPS

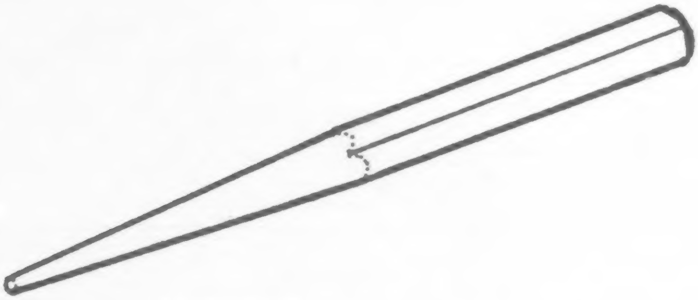
CAST IRON ENGINES

1. Get your equipment. You will need:

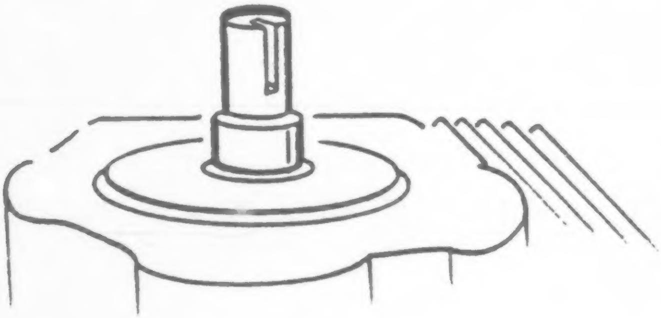
   A file or an emery cloth
   A socket wrench set
   A rubber mallet

   If the engine has BALL BEARINGS you will also need:

   A long punch

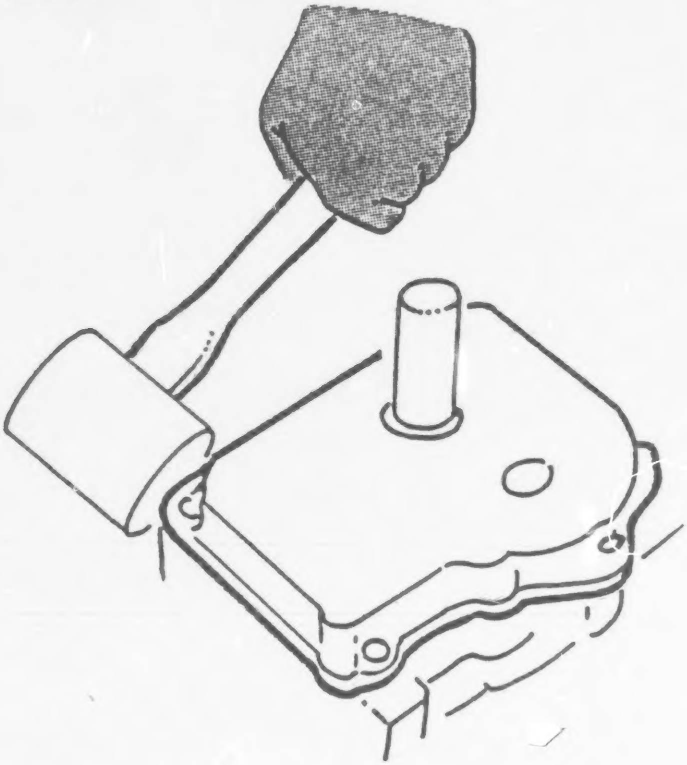


2. Check the power take off end of the crankshaft sticking out from the engine. It must be clean and smooth. Use the emery cloth and file to make sure that there is no rust or burrs on the shaft. Take out the bolts holding the crank cover.

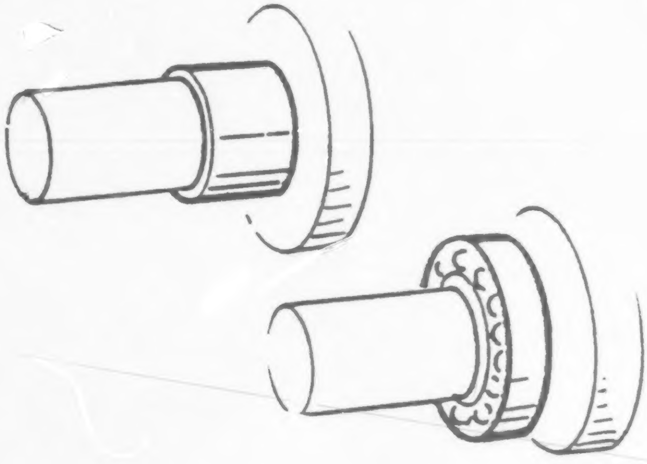


JOB STEPS

3. Pull the cover off over the end of the shaft. If the cover sticks to the engine you can tap it LIGHTLY with the rubber mallet to loosen the seal.



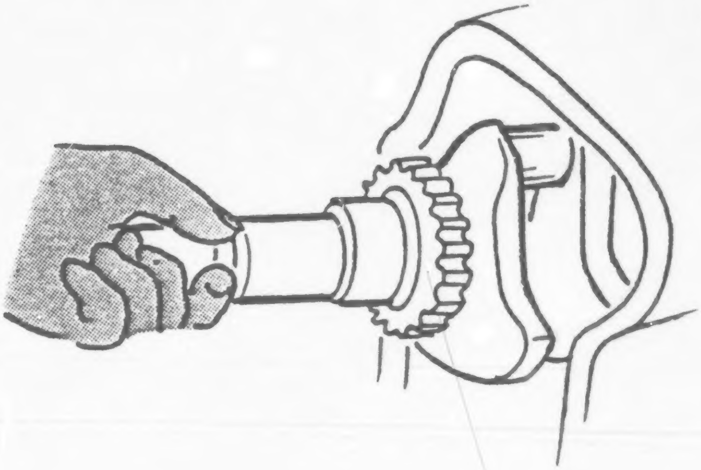
4. Look to see if the engine has plain bearings or ball bearings on the power take off side. Find and follow the directions that go with the type of bearings that your engine has.



JOB STEPS

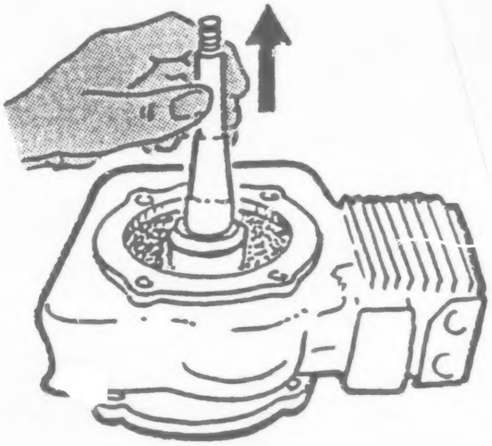
PLAIN BEARINGS

5A. Turn the crankshaft until the crankpin points up and to the rear of the engine. If you have it in the right place, you will be able to pull the shaft out easily. You may have to wiggle the shaft a little to get it in the right position. Do not damage the shaft by forcing it.



BALL BEARINGS

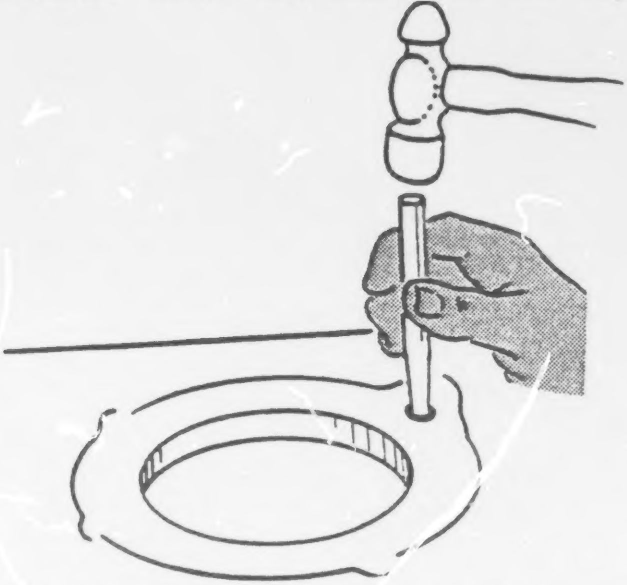
5B. Some engines have ball bearings on the power take off side of the crankshaft. On these engines you have to take the crankshaft out from the magneto side.



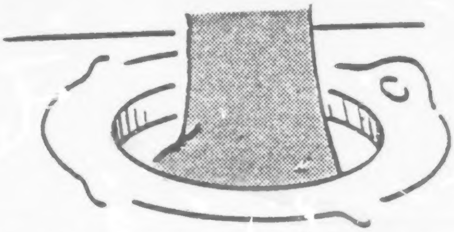
JOB STEPS

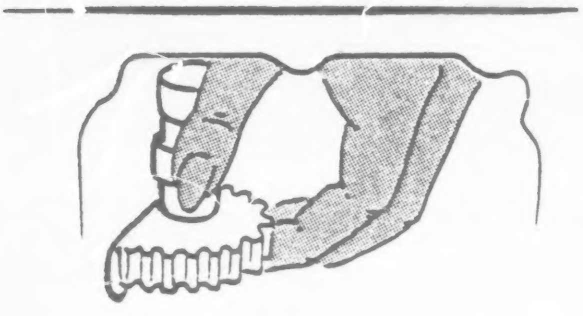
6B. Find the directions for removing the magneto and follow them carefully.

7B. Use a long punch to VERY CAREFULLY tap the cam gear shaft into the engine from the power take off side. Do not damage the shaft. Drive the shaft all the way out of the engine.



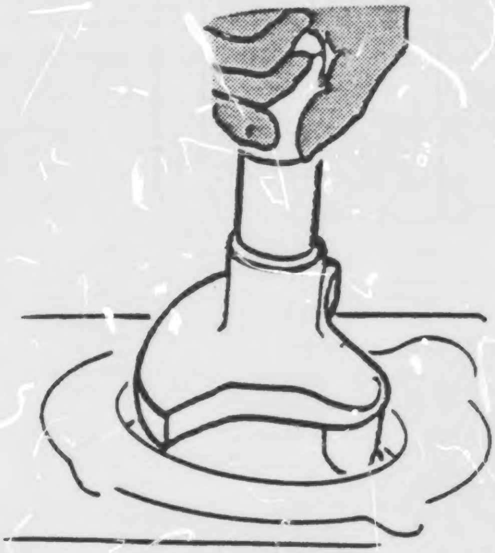
8B. The punch will hold the cam gear. When you pull the punch out be sure to reach in and hold the gear so that it does not fall and get nicked. Push the gear into the space in the crankcase where it will be away from the crank gear.





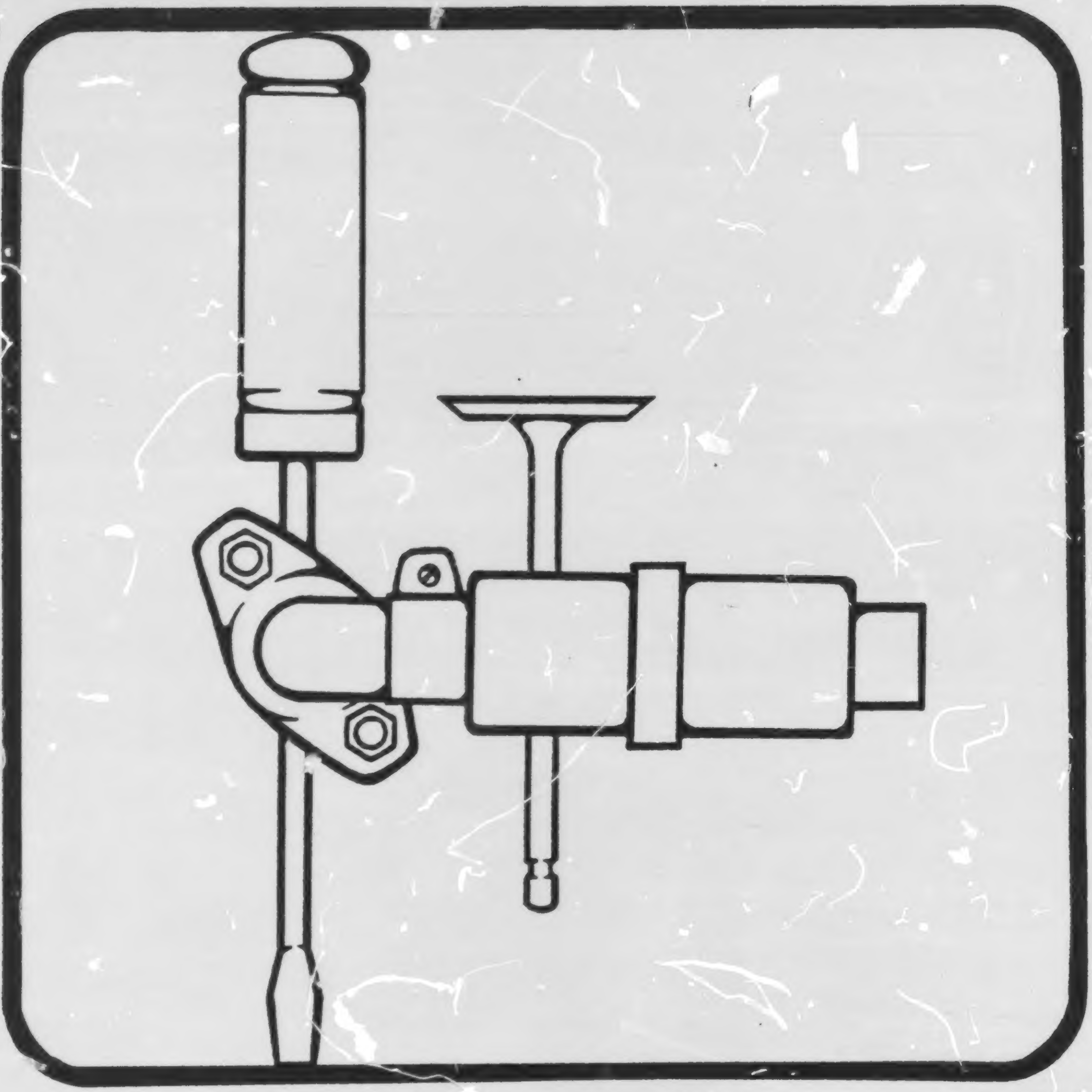
JOB STEPS

9B. You can now pull the crankshaft out from the magneto side.



Now you are ready to inspect and mike the crankshaft (module 7501 01 022).

95-A



small engine repair

unit: AIR FILTER

capital area career center

module: 7501 02 001 date: April 1978 level: I

skill title: Air Filter Service

developed & written by: Don Foster

visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to service common air filters used on air-cooled engines.

IN ORDER TO DO THIS YOU WILL NEED:

An engine with an air filter

Safety Glasses

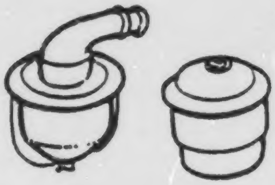
WE WILL KNOW YOU CAN DO IT WHEN:

The filter is cleaned so that it will allow air to pass through, but does not have holes or tears that will allow dirt and dust to pass through.

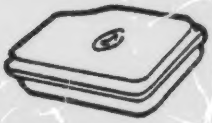
INFORMATION

These are the common types of air filter:

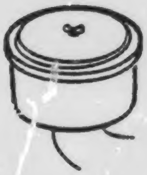
1. Oil Bath Type:



2. Paper Cartridge Type:



3. Oil Foam Type:



JOB STEPS

Oil Bath Type Air Filter

1. Remove the center mounting bolt or nut. Wear your safety glasses.

2. Remove the complete filter from the engine.

3. Remove the top from the filter bowl.

4 Pour the dirty oil from filter bowl into the waste oil pan.

5. Clean both parts of the filter in a solvent.

6. Blow out the top part of the filter with compressed air.

7. Blow dry or wipe dry the lower part.

8. Fill the bowl with the same weight oil as you are using in the crankcase. For summer use 30W, for winter use 5W or 10W.

9. Put parts back and put complete filter on the engine. Tighten center mounting nut.

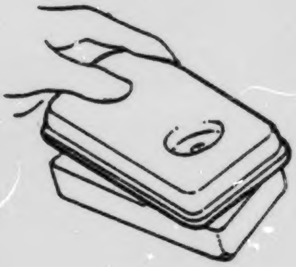
JOB STEPS

Oil Foam Type Air Filter

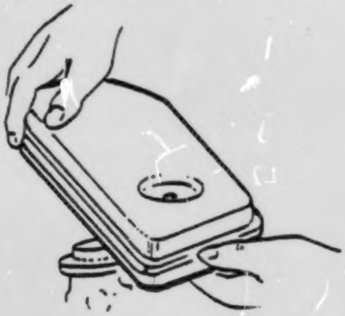
1. Remove the center mounting bolt or nut.

   NOTE: On some Tecumseh engines there is just a cover that snaps on.

2. On Briggs & Stratton oil foam type, remove the entire filter and clean it in solvent.

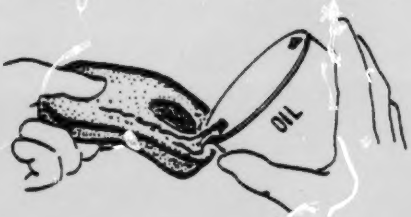


On Tecumseh, remove the filter element and clean it in solvent.



3. Blow dry the entire filter with compressed air. Be sure the element is dry so that the solvent won't dilute the oil that you are going to put on it.

4. Saturate the filter with the same weight oil as used in the crankcase. For summer use 30W, for winter use 5W or 10W.

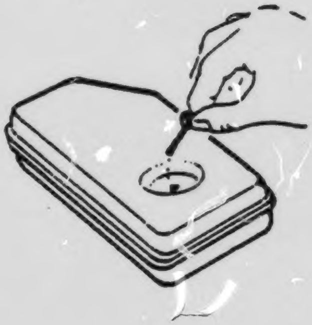


JOB STEPS

5. On Briggs & Stratton filters, put the element in the lower body of the filter (DO NOT tuck the lip of the element into the filter body; it must hang outside of the body to seal the top of the filter).

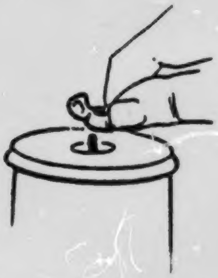
   On Tecumseh filters just put the filter element into the filter body.

6. For Briggs & Stratton, put the cover on the lower filter body. Then put the filter on the carb and tighten the screw or nut until the filter is tight. On Tecumseh, snap the cover in place.



Paper Cartridge Type Oil Filter

1. Remove the center filter nut. Some Tecumseh engines use a clamp. Use pliers to remove it.



JOB STEPS

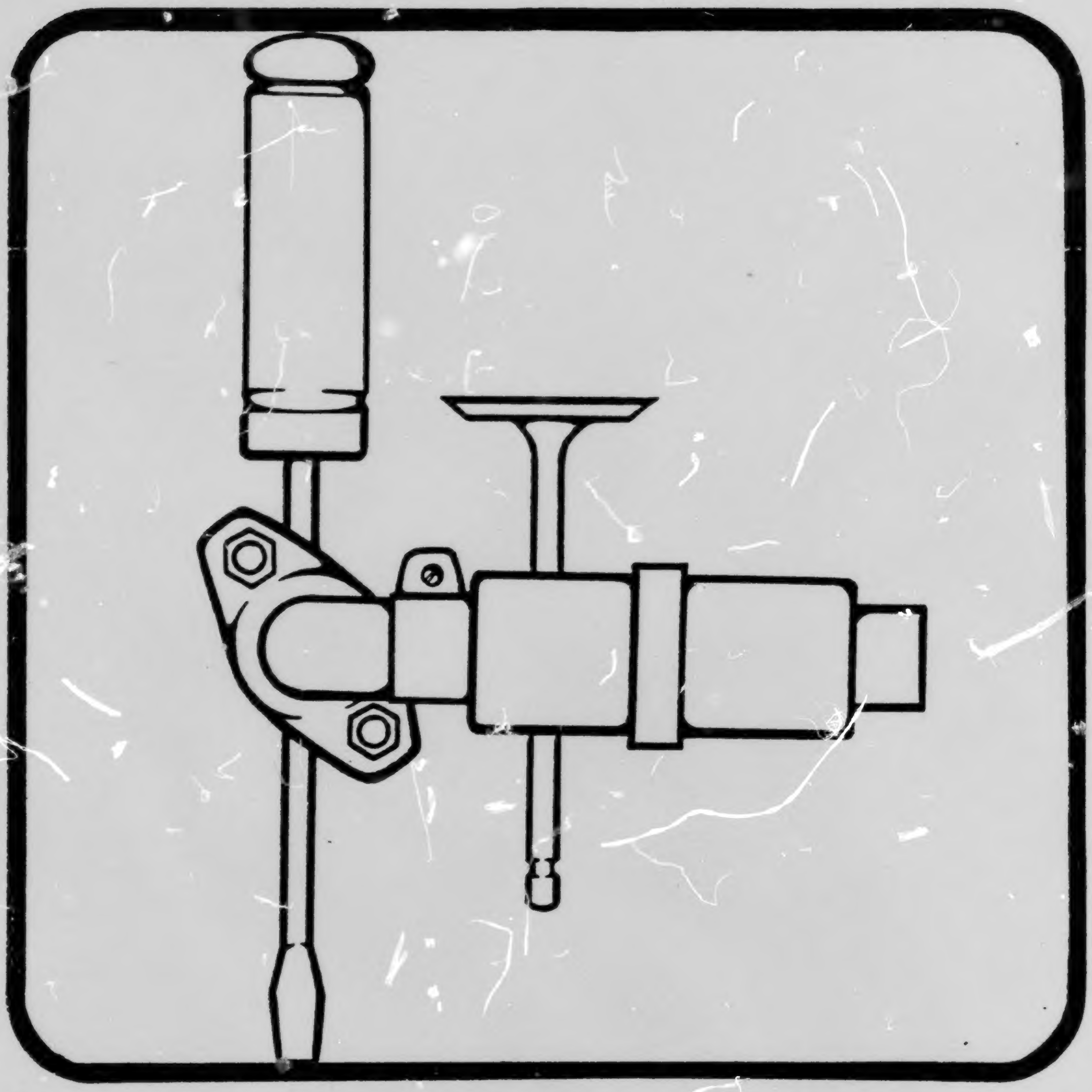
2. Remove the filter cover if it is used. If Tecumseh type filter is held on with a clamp there will not be a cover.

3. Remove the filter element and tap it on a bench. Then blow it out from the inside of the filter with compressed air, or wash it in a non-sudsing detergent and set it out to dry.

4. Check for holes or tears in the paper. You may want to put a light on the inside of the filter to show up any rips or tears.

5. If the filter element is all right, clean and has no holes, install the filter back on the engine. If there are holes or the filter is not clean, replace it.

6. Install the clamp or the center mounting nut.



small engine repair

unit: AIR FILTERS

capital area career center

module: 7501 02 002 date: October 1977 level: I

skill title: Check For Air Bypassing The Air Filter

developed & written by: Don Foster

visuals by: Steve Bramer

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

Where to look for places that air may bypass air filters and how to service those places.

AND IN ORDER TO DO THIS YOU WILL NEED:

An engine with an air filter and tools.

WE WILL KNOW YOU CAN DO IT WHEN:

You can explain that the air is or is not bypassing the filter, and if it is, you will explain to the instructor how you repaired it.

WORD GUIDE

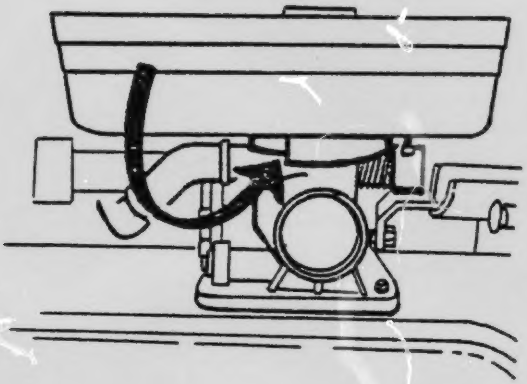
AIR HORN - A metal cone above carb that is shaped like a horn.

INFORMATION

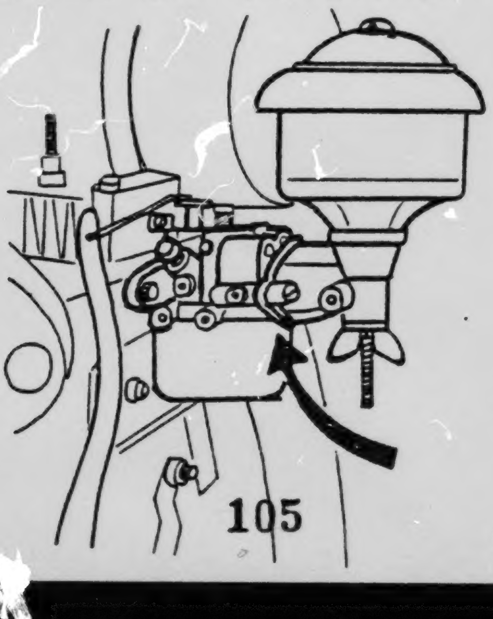
If air is allowed to bypass the filter, dirt and dust will get into the engine. This will cause the engine to run hotter, and may even ruin some parts. Therefore, it is important that you check filter mounts and gaskets for bypass.

There are different kinds of filters, but all air filters have a gasket of some kind between the filter and the carburetor.

On Briggs and Stratton engines the gasket is usually rubber and fits on the carburetor:

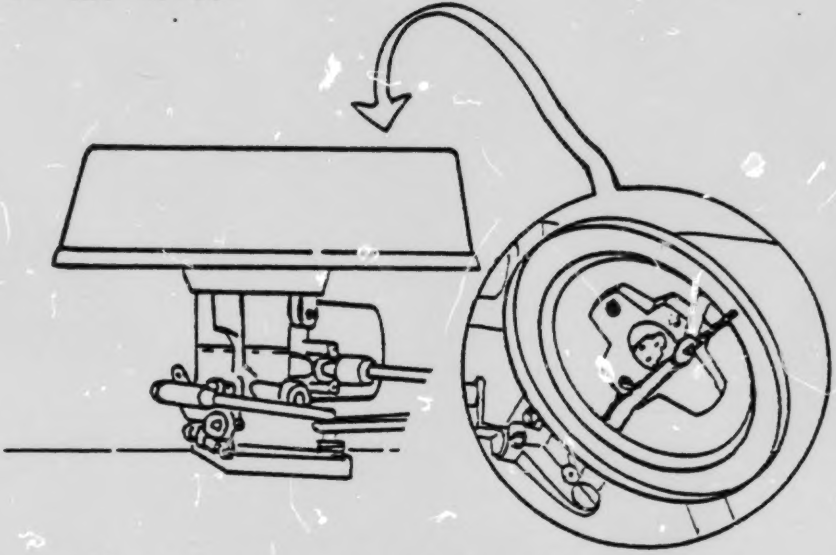


Some engines have air filters mounted to an air horn, and there is then a gasket between the air horn and carburetor:



INFORMATION

Some engines use a light metal cover attached to the carb and may use 2 or 3 screws to hold the cover on to the carb. When you remove the cover, you can check the filter. There may be a gasket around the edge of the cover.



Now, read all the job steps for this module. Then use the job steps that apply to the filter type of the engine you are working on.

WORD GUIDE

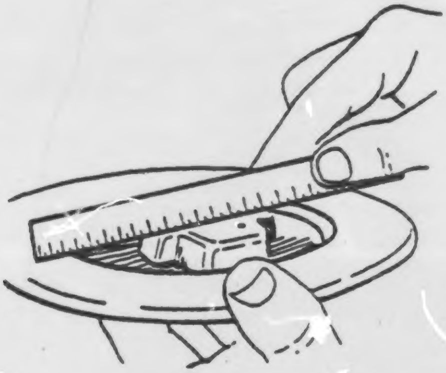
STRAIGHT EDGE - Ruler or straight piece of metal or wood.

JOB STEPS

1. Check your engine for the type of air filter you will be working with.

   NOTE: If your engine is the kind without a gasket, go to step 2. If it has an air horn type, go to step 7. If it has the Briggs & Stratton type, go to step 14.

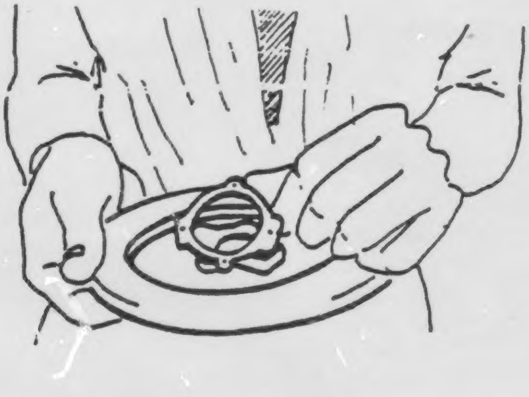
2. For filters that are held directly to the carb by a light cover, check the cover to be sure it is not bent or warped. Use a straight edge.



3. If the cover is bent or warped around the edge, dust or dirt can get in. Replace the cover with a new one.

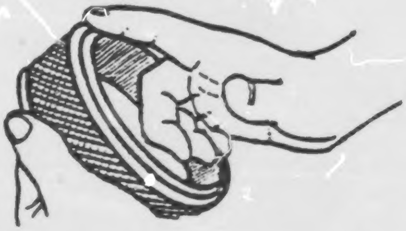
4. If the cover was good, remove it from the carb. Clean the filter as in module 7501 02 001.

5. Check the gasket around the edge for cracks or breaks. Replace it if needed.

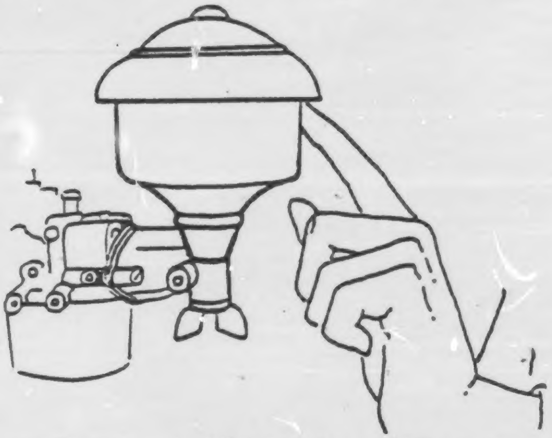


JOB STEPS

6. Put a light coating of oil or grease on the gasket, and also around the sealing edge of the air filter. Then replace cover.

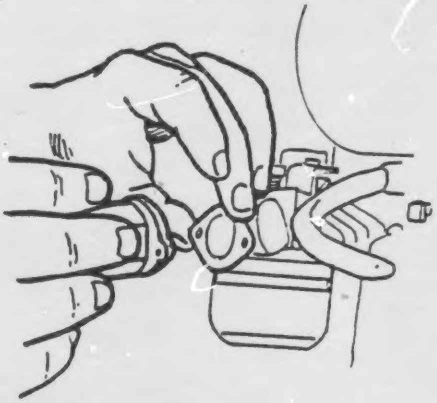


7. If your carb has the filter mounted on an air horn, check the cover of the air horn for warp or dents around the edge.



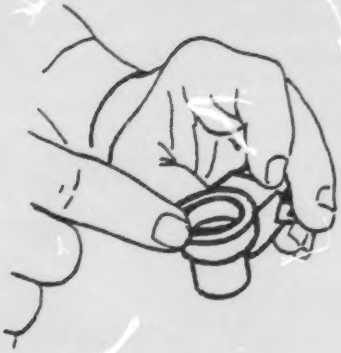
8. If cover is warped or bent, replace it with a new cover.

9. Remove the air horn and check the gasket between the air horn and carb. There should be no cracks or breaks. If there are, put on a new gasket.

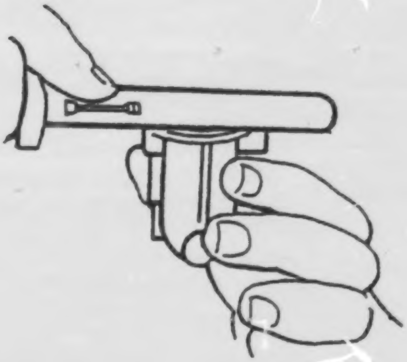


JOB STEPS

10. Also check for a gasket or O-ring between air horn and filter.



11. Also check air horn for warp. Each edge should be flat. Use a straight edge.

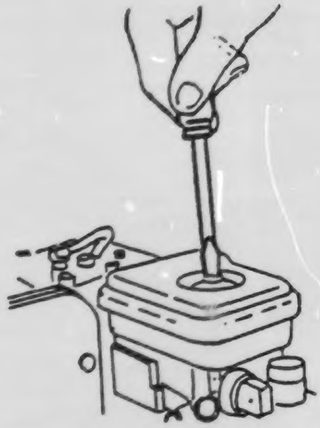


12. Put a light coating of oil or grease on the gasket sealing surface. Then replace it on the carb and put the air horn back on.

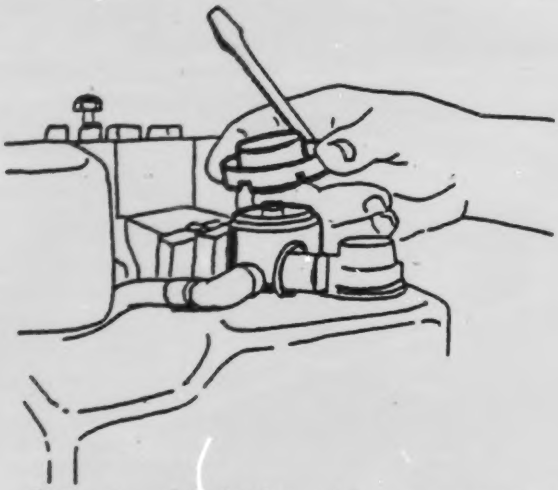
13. Clean and check the air filter as in module 7501 02 001. Then put the cover back on.

JOB STEPS

14. If you have a Briggs & Stratton type of air filter, remove the air filter housing by loosening the center bolt.



15. Then check the large rubber gasket for cracks or breaks. If needed, replace with a new gasket.



16. After checking the air filter, lightly oil or grease the gasket, then replace air filter housing.

17. Have your instructor check your work. Explain how you serviced your air filter and how you sealed it.

small engine repair

unit: Starters

capital area career center

module: 7501 03 001 date: 6/77 level: I

skill title: Remove and Replace Starters

developed & written by: Jim Pitts

visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to remove and replace a wind-up starter assembly on a small engine.

AND IN ORDER TO DO THIS YOU WILL NEED:

Hand tools

Engine with a starter

Service manual

WE WILL KNOW YOU CAN DO IT WHEN:

The starter assembly is put back on the engine according to service manual specifications.

WORD GUIDE

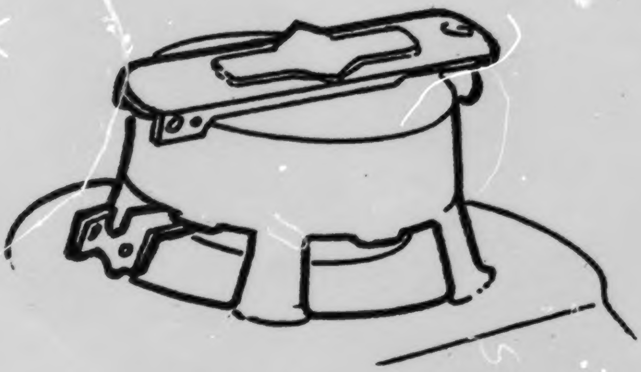
IMPULSE - Force that turns over the engine.

RECOIL - Spring back.

INFORMATION

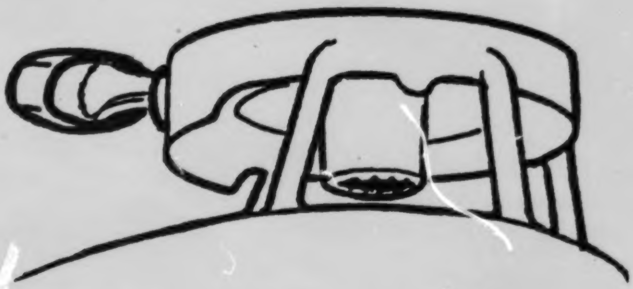
There are two main types of starters on small engines. One is an impulse or a wind-up starter. The other is a re-wind type of starter.

The impulse or wind-up starter looks like this:



Note the control lever. It must be on "crank" to wind up the starter. When the lever is on "release", the engine will start.

The re-wind starter looks like this:

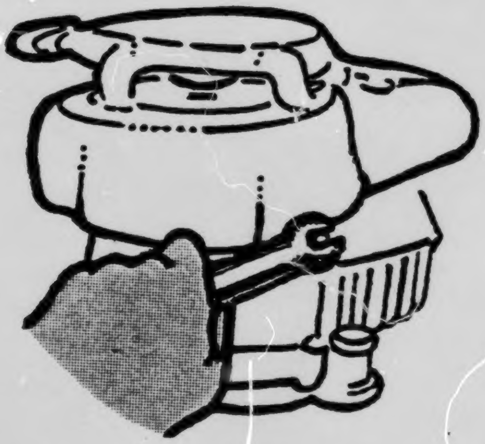


To start the engine, you pull on the starter rope. The rope will recoil back into the housing.

JOB STEPS

1. Get your equipment and service manual. Take it to your work area.

2. Since the starter assembly is mounted on the blower housing, first remove the blower housing bolts. There are bolts in 3 or 4 places.



3. Now, lift the housing off the engine.

4. If the engine has a re-wind starter, pull out the starter rope to see if it is worn out. If it is, tell your instructor.

5. Release the starter rope to see if it goes back into the housing.

6. Put the starter housing back onto the engine.

7. Replace the bolts, be sure they are tight.

8. Wind up the starter spring and release it. See that the starter works properly (if you have a re-wind starter, pull the rope and release it).

9. Ask your instructor to check your work.

small engine repair

unit: Starters

capital area career center

module: 7501 03 002 date: 6/77 level: I

skill title: Replace Recoil Springs

developed & written by: Jim Pitts

visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

You are going to learn:

How to replace recoil springs on a Briggs & Stratton rewind starter.

And in order to do this you will need:

Hand tools

Briggs & Stratton engine with rewind starter

Module 7501 03 001

Briggs & Stratton Service Manual

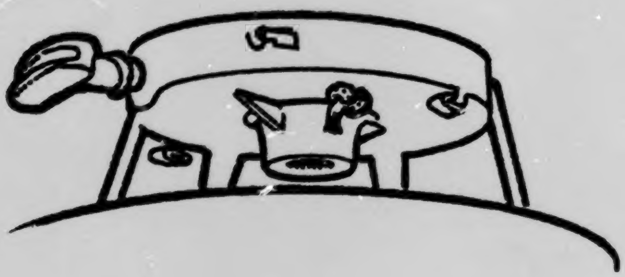
3/4" square piece of metal

We will know you can do it when:

You have replaced a recoil spring on a Briggs & Stratton rewind starter so it works according to service specififcations.

INFORMATION

A Briggs & Stratton rewind starter assembly looks like this:



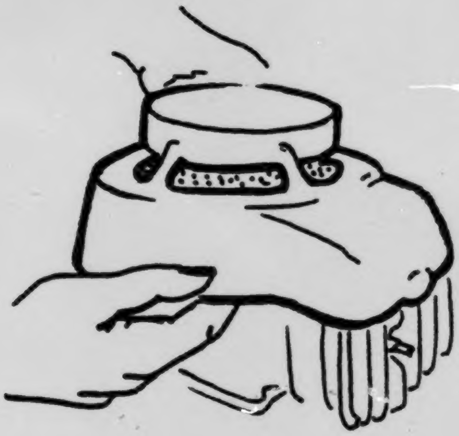
The starter recoil spring is under the housing. If this spring is worn out or broken it should be replaced. If you need information on other types of starters, look it up in the Small Engine Service Manual or the Briggs & Stratton Service Manual, section 7.

If you have a vertical pull starter, refer to section 7, page 5 in the Briggs & Stratton Manual.

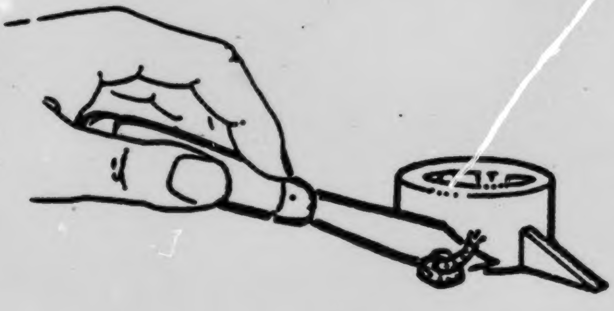
JOB STEPS

1. Take all the equipment to the work area.

2. Remove the blower housing from the engine. See module 7501 03 001.

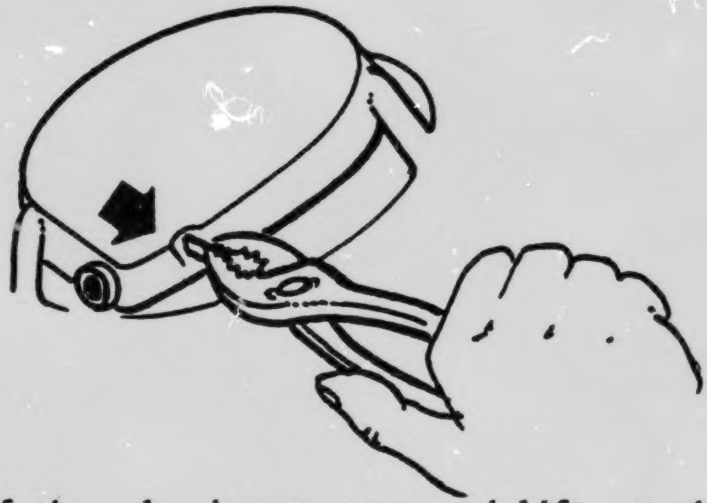


3. Cut the knot in the rope at the end at the starter pulley. Remove the rope.

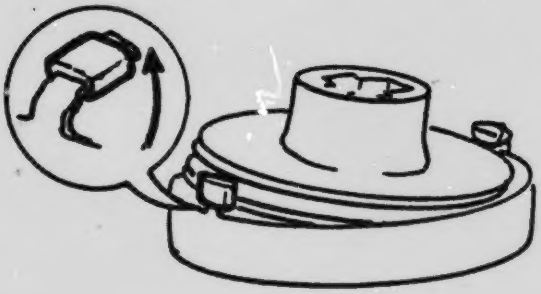


JOB STEPS

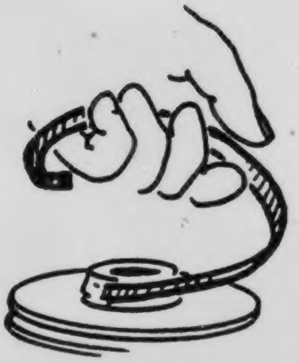
4. Pull out the outer end of the starter spring as far as it will go.



5. Bend up one of the nylon bumper tangs and lift out the starter pulley.



6. If the spring is broken in two, remove the rest of the spring from the pulley.

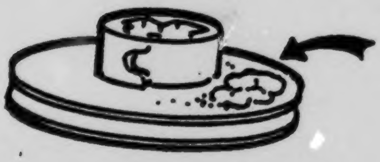


JOB STEPS

7. Clean the starter spring in solvent.

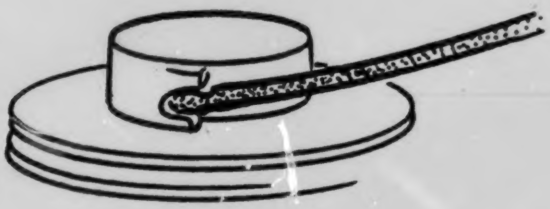
8. Then, clean up the pulley. Wipe it with a rag by pulling the rag through the pulley.

9. Put a small amount of grease on the inner face of the pulley.



10. Straighten the spring so it can be installed more easily.

11. Put one end of the spring through the starter housing spring hole and hook it into the slot in the pulley.



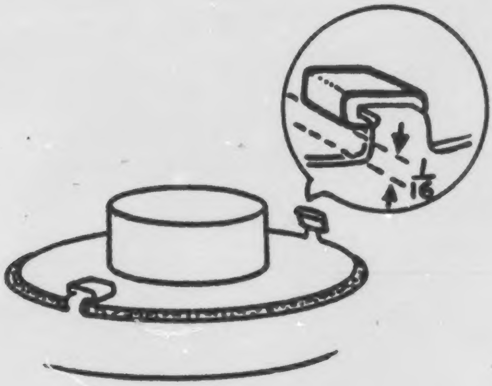
WORD GUIDE

COUNTER-CLOCKWISE - To the left.

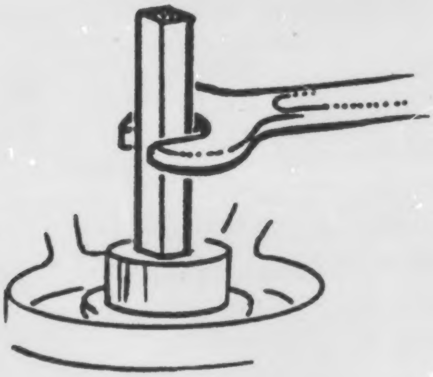
JOB STEPS

12. Replace the nylon bumpers, if they are worn.

13. Put the pulley into the blower housing and bend the tang down. It should be 1/16 of an inch from the pulley.

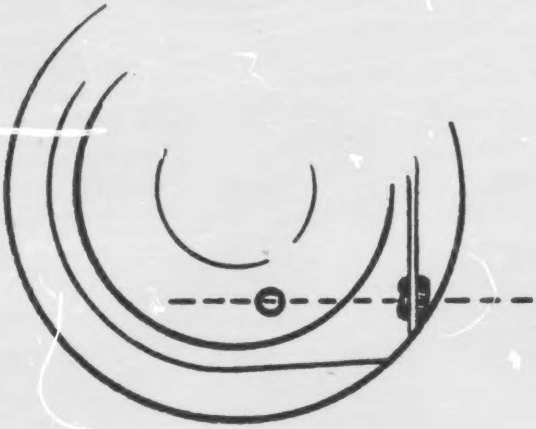


14. Put a 3/4 inch piece of metal into the center of the pulley hub. Wind the spring counter-clockwise until the spring is wound tight.

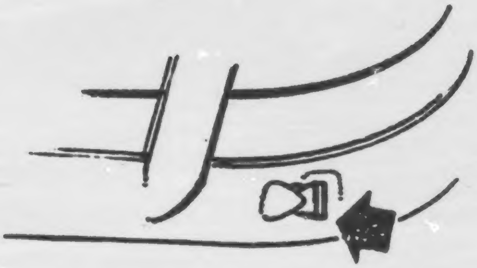


JOB STEPS

15. Back off the pulley one turn until you line up the hole in the pulley for the rope knot and the eyelet in the blower housing.



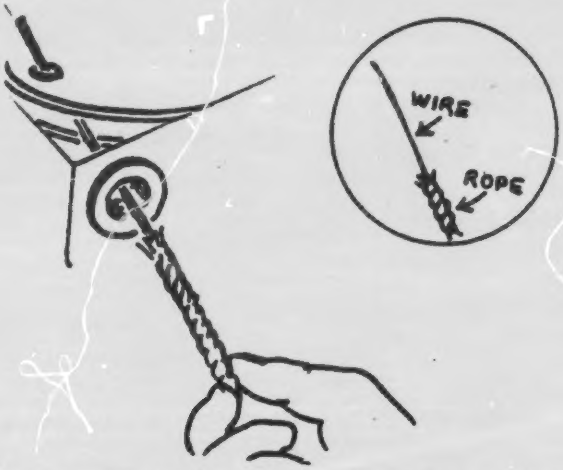
16. Be sure the spring is locked in the tapered portion of the hole.



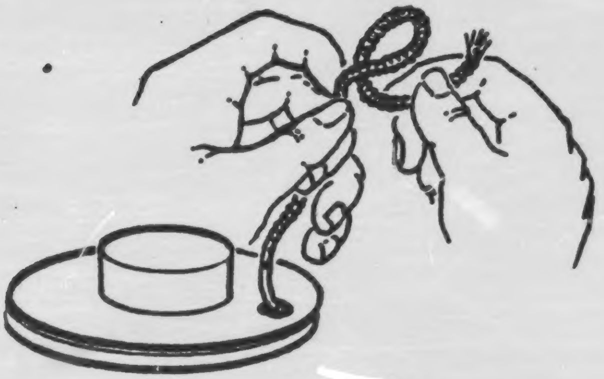
17. If the old starter rope is worn, get a new one.

JOB STEPS

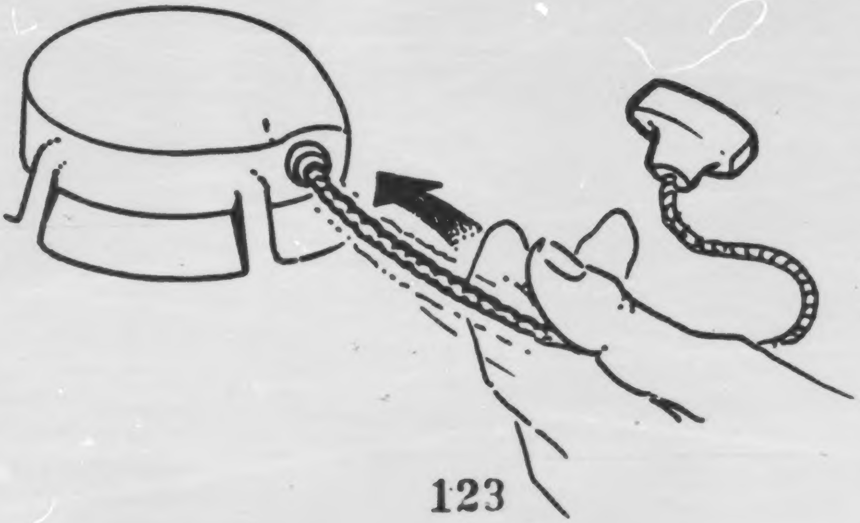
18. Put one end of the rope through the hole in the starter housing and the pulley. You can use a piece of wire to guide the rope.



19. Tie the end of the rope so it will not come out of the hole.



20. When you release the pulley, the rope will wind into the pulley and housing assembly.



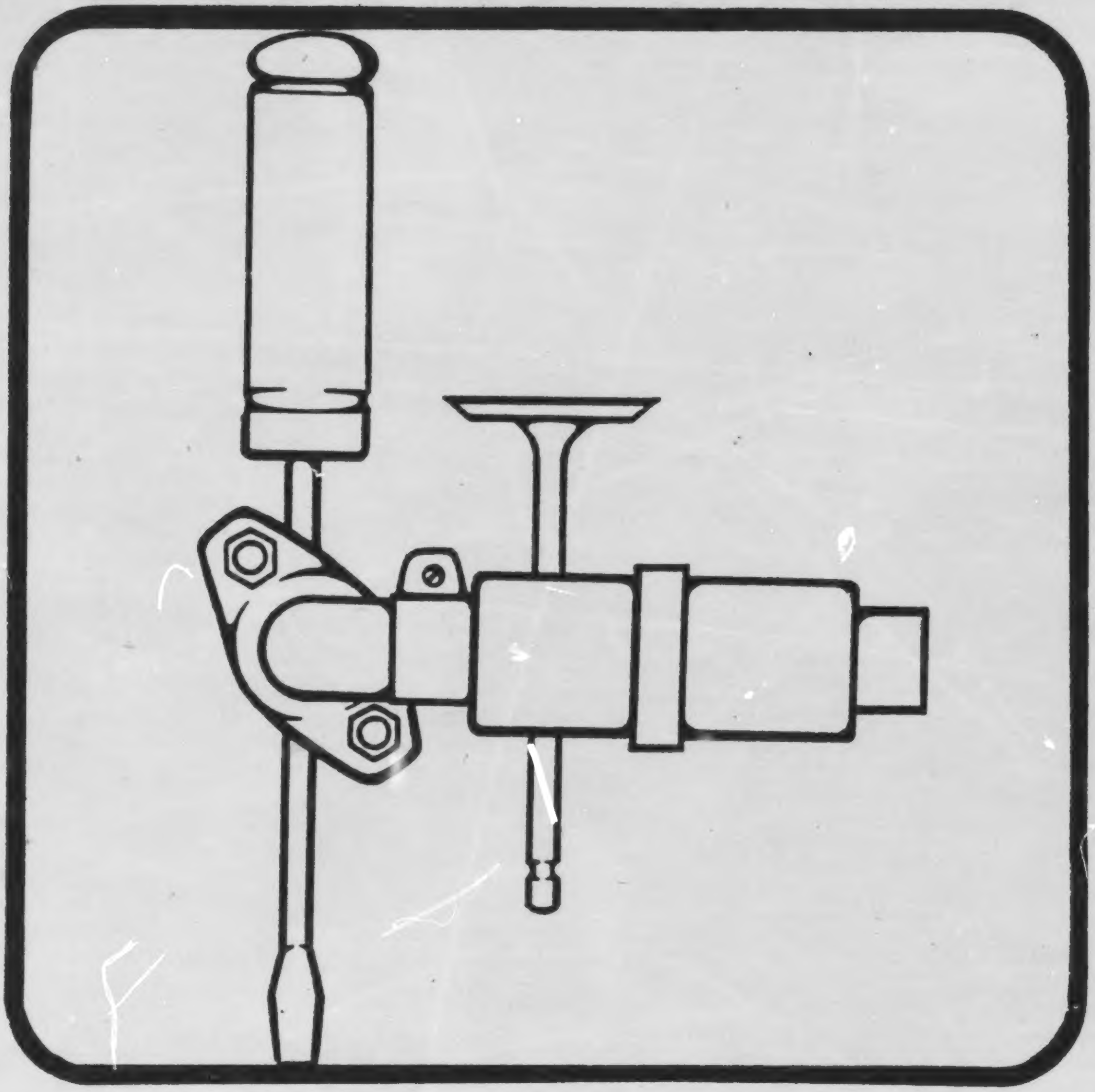
JOB STEPS

21. Put the housing assembly back onto the engine.

22. Check the oil and fuel.

23. Start the engine to be sure it works properly.

24. Ask your instructor to check your work.



small engine repair

unit: STARTERS

capital area career center

module: 7501 03 003 **date:** July 1977 **level:**

skill title: Remove and Replace Starter Clutches

developed & written by: Jim Pitts

visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to disassemble late model starter clutches on a Briggs and Stratton engine.

AND IN ORDER TO DO THIS YOU WILL NEED:

Briggs and Stratton engine with starter clutches

Briggs and Stratton tool #19114

Briggs and Stratton manual

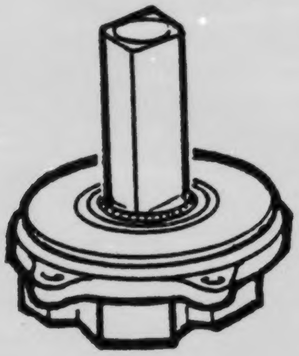
Safety glasses

WE WILL KNOW YOU CAN DO THIS WHEN:

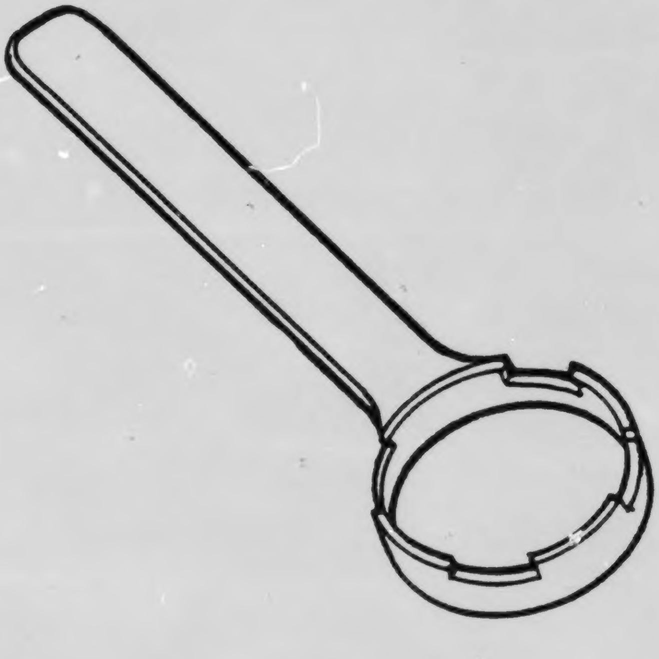
You have taken apart and put back together the Briggs and Stratton late model starter clutches according to service manual specifications.

INFORMATION

Briggs & Stratton makes an early and late model starter clutch assembly. This module will teach you how to service the late model clutch assembly. If you have an early model, refer to page 58 of the Small Engine Service Manual. The late model clutch looks like this:



To service the clutch, you need a special Briggs & Stratton tool #19114. It looks like this:



WORD GUIDE

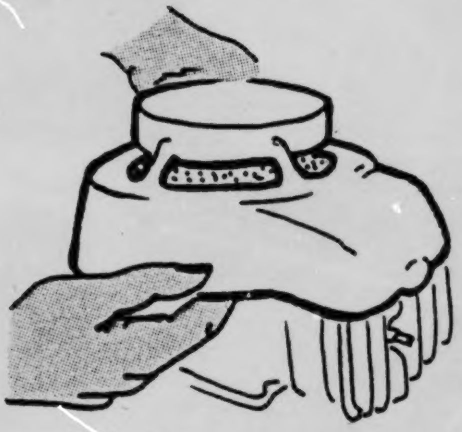
COUNTER-CLOCKWISE - To the left.

CLOCKWISE - To the right.

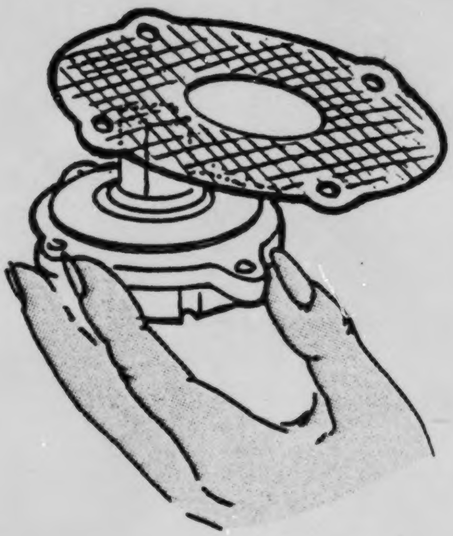
JOB STEPS

1. Take your equipment to your work area. Wear your safety glasses!

2. Remove the blower housing, if the clutch assembly is mounted on an engine.

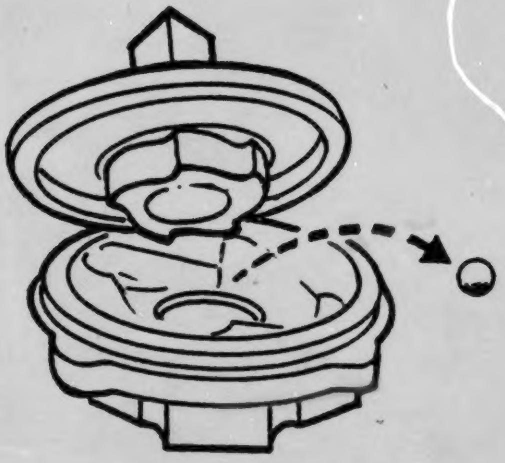


3. Take off the rotating screen, starter ratchet cover, and seal. They are bolted to the clutch housing.

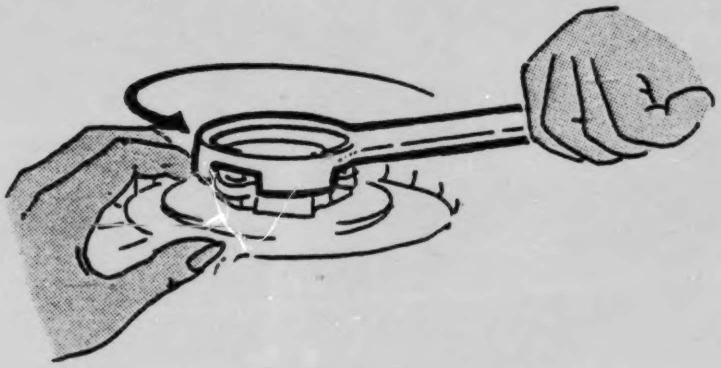


JOB STEPS

4. Lift the ratchet from the housing and take out the steel balls.



5. Hold the flywheel and unscrew the housing counter clockwise. You need to use the Briggs & Stratton tool #19114 to do this.



6. Inspect the starter ratchet, housing and steel balls for wear. Replace them, if they are worn out.

JOB STEPS

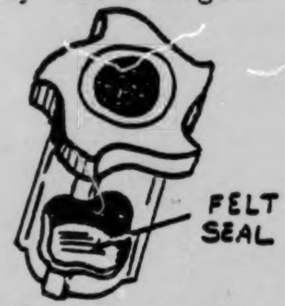
7. Clean the old grease off all parts.

8. Put the housing back on the flywheel. Use the Briggs & Stratton tool #19114 to tighten it clockwise.

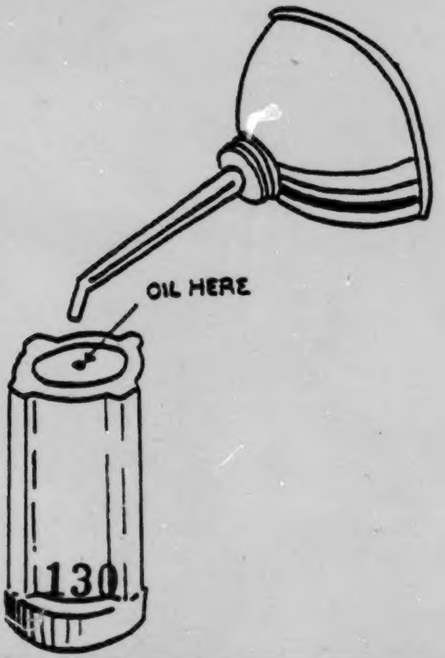
   NOTE: Be sure the spring washers are put back in with the the cup side toward the flywheel.

9. Clean the steel balls and put them back in place. DO NOT LUBRICATE the balls.

10. Check the felt seal and plug in the outer end of the ratchet. Put the new ones in if they are damaged.

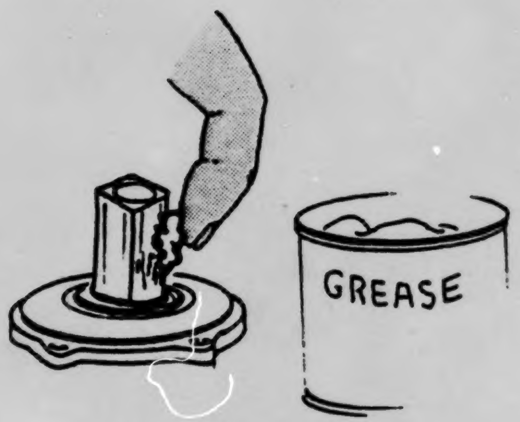


11. Lubricate the felt with oil and put the ratchet on the crankshaft.



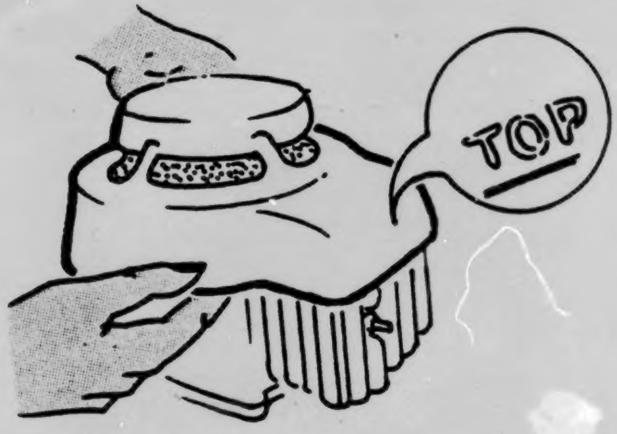
JOB STEPS

12. Put a small amount of grease on the ratchet and shaft.



13. Put the cover, rotating screen and rubber seal on the housing. Bolt them in place.

14. Put the blower housing back on the engine. The word "top" should face the engine cylinder head.



JOB STEPS

15. Check the fuel and oil.

16. Start the engine.

17. Ask your instructor to check your work.

small engine repair

unit: Starters

capital area career center

module: 7501 03 004 date: 7/77 level: I

skill title: Replace Starter Rope

developed & written by: Jim Pitts

visuals by: Dave Wehrwin

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to replace a starter rope on a Briggs and Stratton engine with a recoil starter.

IN ORDER TO DO THIS YOU WILL NEED:

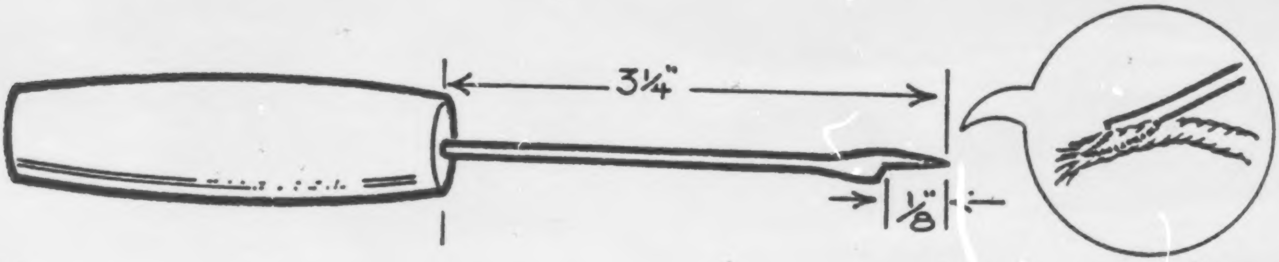
B & S engine with recoil starter
New rope
Rope inserter tool
B & S Service Manual
Safety Glasses

WE WILL KNOW YOU CAN DO IT WHEN:

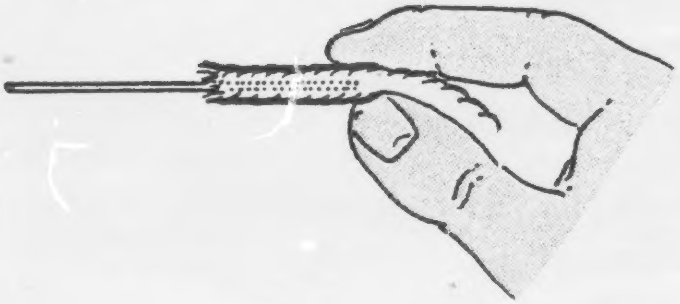
You have replaced the rope to a recoil starter so that it returns to the housing without hanging out or coming loose.

INFORMATION

When the starter rope gets frayed or broken, it must be replaced. When you get the new rope, be sure it is the right diameter and length. A rope inserter tool may be used to push the rope through the pulley.



A wire also can be used:



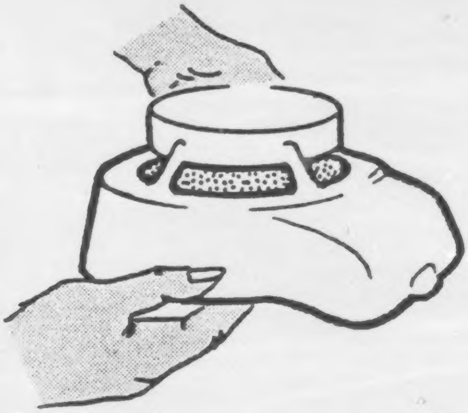
The starter pulley and spring should not have to be removed from the housing to change the rope.

WORD GUIDE

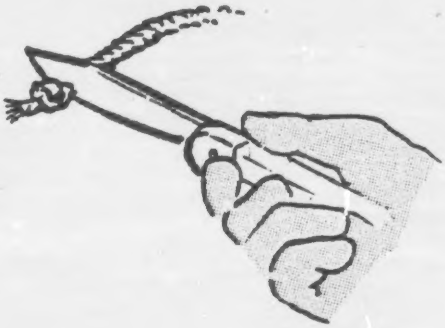
COUNTER CLOCKWISE - To the left.

JOB STEPS

1. Take all equipment to your work area. Wear your safety glasses.
2. Remove the blower housing from the engine.



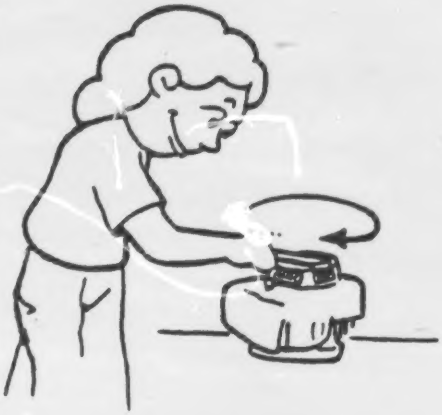
3. Cut off the knot from the pulley and take the old rope out of the pulley.



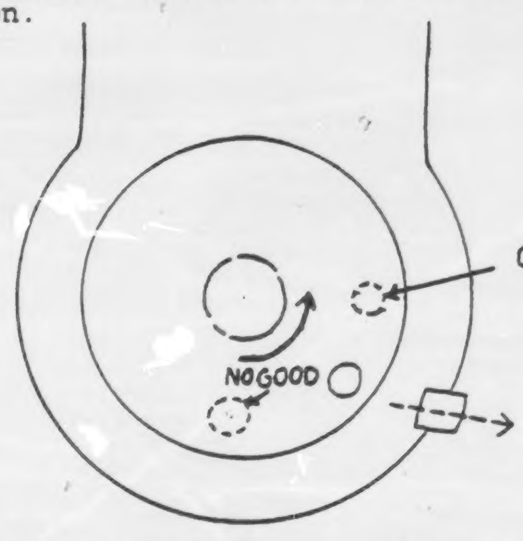
4. Tie the new rope in the handle.

JOB STEPS

4. Put a spring winder in the pulley knob and turn the hub counterclockwise until the spring is TIGHT. See where the hole for the rope is. If it is not past the hole in the housing, then back off the pulley one complete turn. The spring must have a cushion when the rope is pulled all the way out.



5. Back off the pulley until the holes in the housing and pulley are lined up. If it is like the no good in the illustration, then it should be backed off on full turn so that there is a cushion.



6. Tie a knot in the rope.

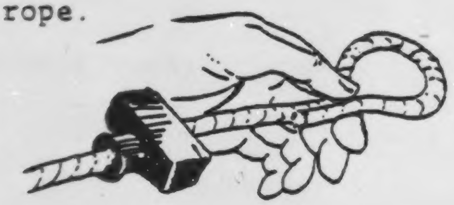
7. Using wire or rope inserter tool, feed the new rope into the pulley. See picture in job step #6. And out of the air housing hole.

JOB STEPS

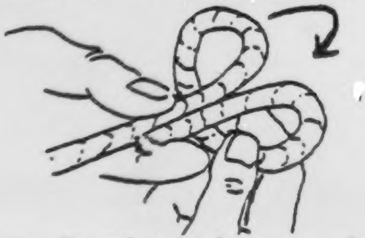
8. Tie the handle on to the rope. By the following steps:

   A. Slide the rope through the handle. Slide the handle about half way down the rope.

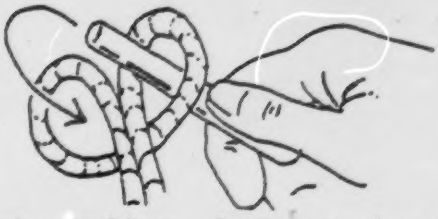
   B. Now make a U in the rope.

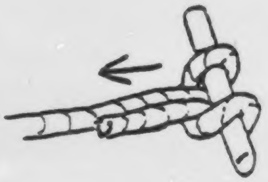


   C. Now bend the rope backward in your hand to form a pretsel.

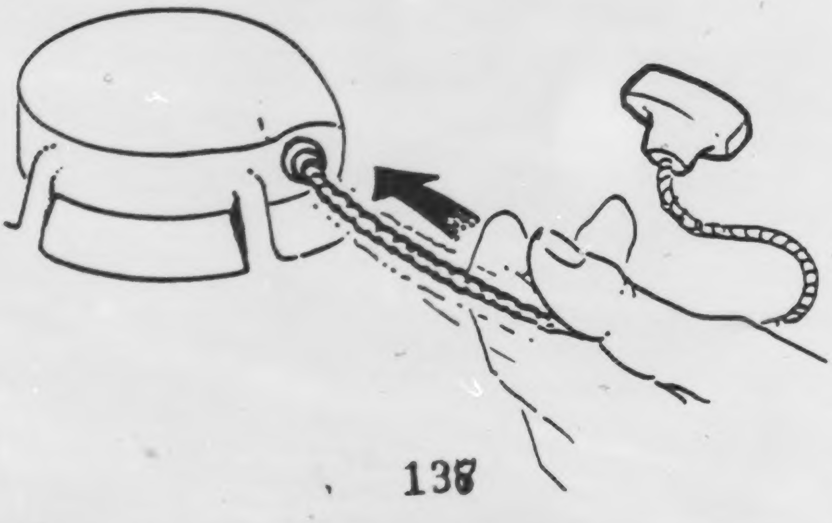


   D. Take the pin and put it through one side of the pretsel and twist it toward you until the pin can go through the other side of the pretsel and pull tight.





9. Release the pulley, letting the spring wind the rope into the pulley.



small engine repair

unit: Starters

capital area career center

module: 7501 03 005 **date:** 7/77 **level:** I

skill title: Wind-Up Starter

developed & written by: Jim Pitts

visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to service a Briggs & Stratton wind-up starter

AND IN ORDER TO DO THIS YOU WILL NEED:

Briggs & Stratton engine with a wind-up starter

WE WILL KNOW YOU CAN DO IT WHEN:

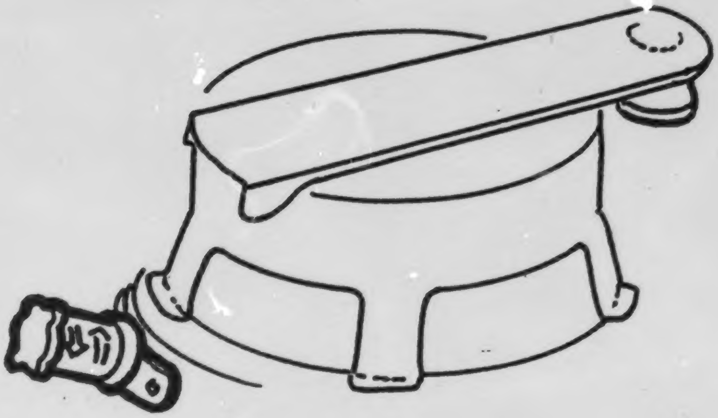
You have serviced the wind-up starter according to service manual specifications.

WORD GUIDE

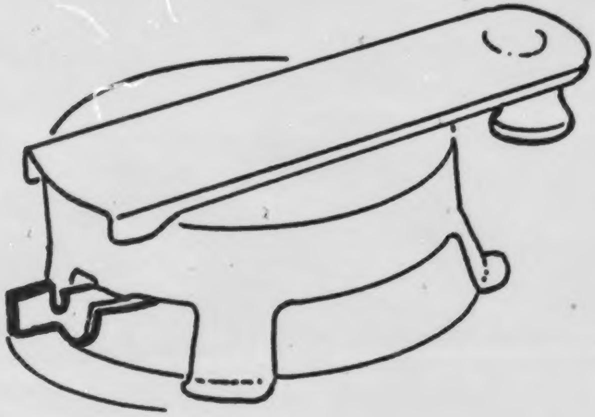
COUNTER-CLOCKWISE - To the left.

INFORMATION

There are two types of wind-up starters. This module will teach you to service the late model. If you have an early model, refer to Small Engine Service Manual, page 56. The early model has a control knob and the late model a control lever.



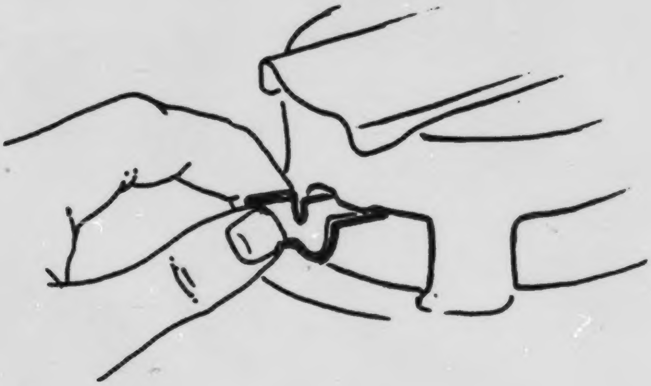
Before you work on the engine, be sure the spring is not wound. You can tell this by trying to turn the crank counter-clockwise. If the spring is wound, release the tension by moving the control lever to the start position. For more information, refer to the Briggs & Stratton Service Manual, section 7, page 4. You can refer to the picture below when working on the starter.



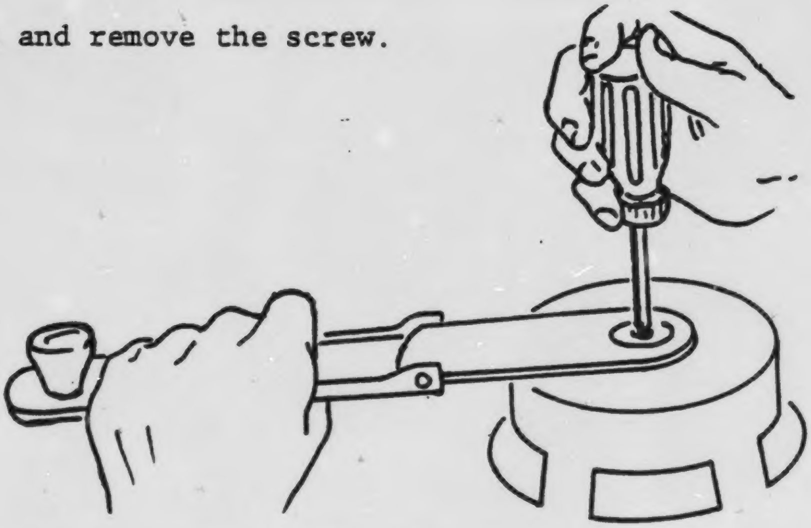
JOB STEPS

1. Take all equipment and materials to your work area.

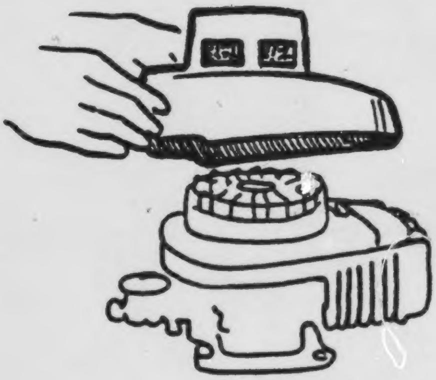
2. Move the control lever to "start".



3. Hold the crank and remove the screw.

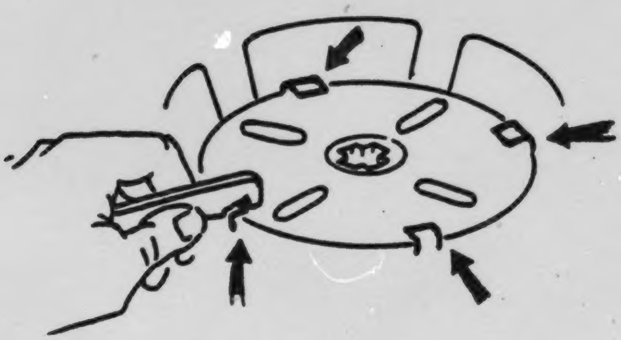


4. Remove the blower housing from the engine.



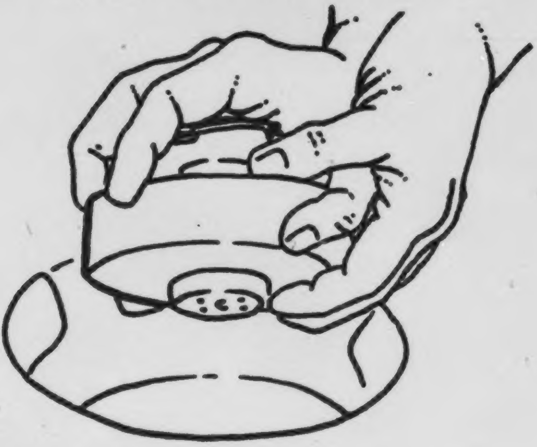
JOB STEPS

5. Turn the blower housing over and bend out the tangs.



6. Lift the cup, spring, and control lever assembly from the blower housing. Ask your instructor to show you the right way to do this.

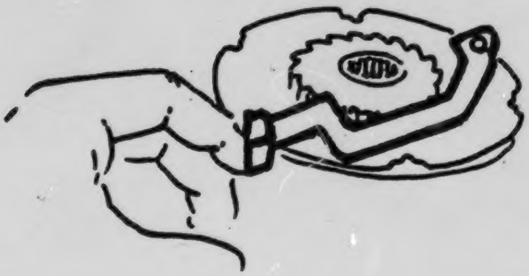
CAUTION: DO NOT TAKE THE CUP AND SPRING APART.



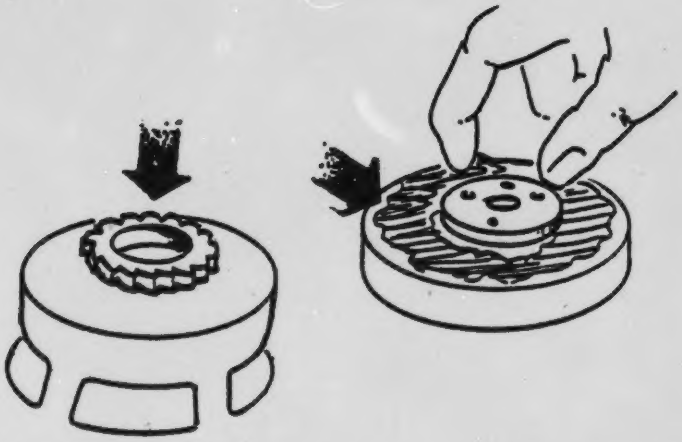
7. Inspect spring and housing assembly for breakage or damage. Inspect ratchet gear for breakage or damage.

JOB STEPS

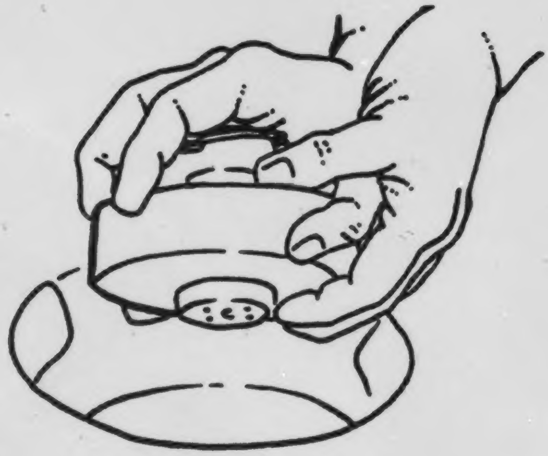
8. Check to see that the control lever moves freely.



9. Grease the mating surfaces of the spring cup and blower housing.



10. Put the spring washer into the housing. Put the cup, spring and release assembly in the housing. Bend the tangs down.



JOB STEPS

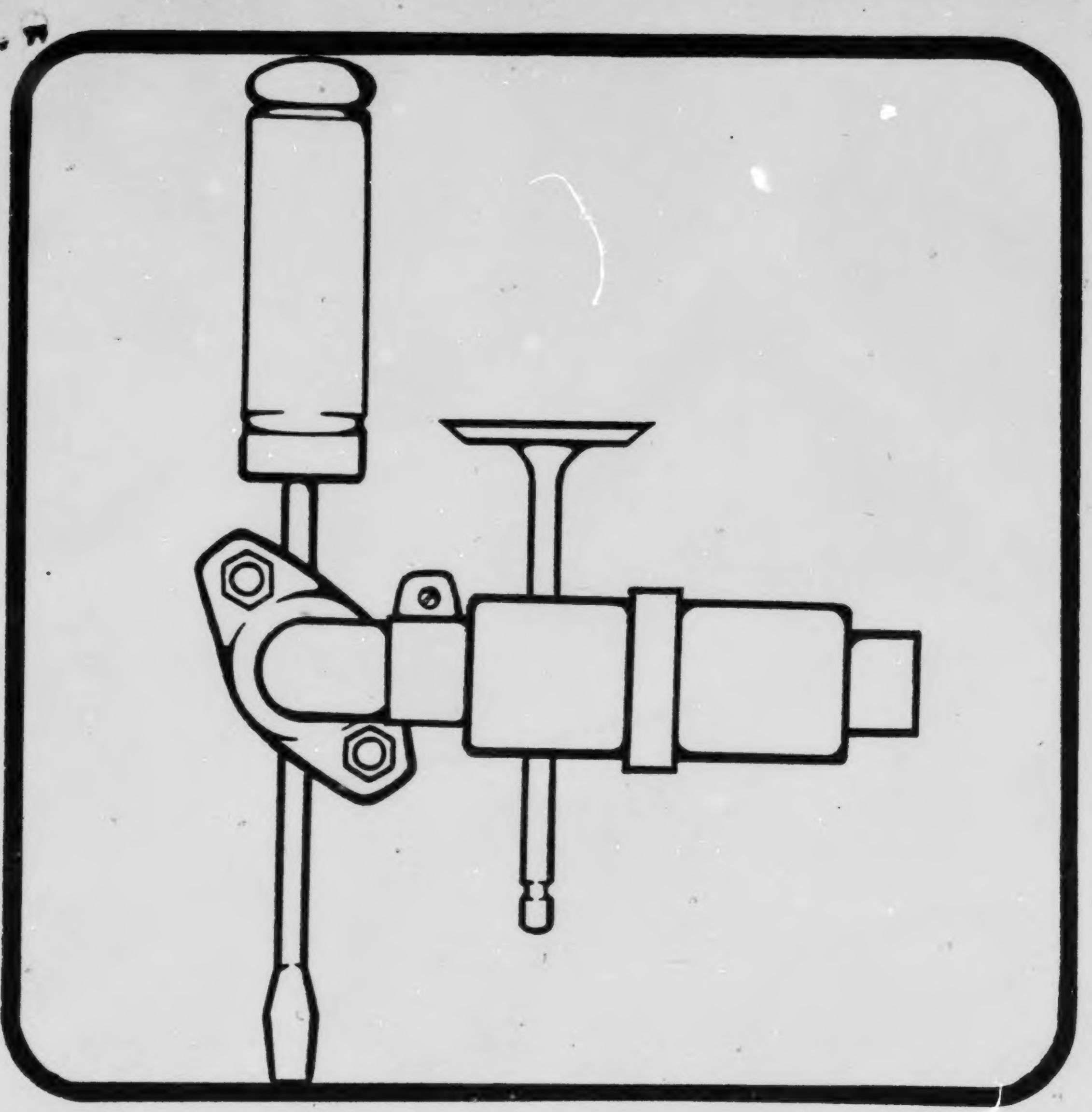
11. Replace the crank and screw.

12. Put the blower housing back onto the engine.

13. Check the fuel and oil.

14. Start the engine to see that it works properly.

15. Ask your instructor to check your work.



small engine repair

unit: STARTERS

capital area career center

module: 7501 03 006 date: July 1977 level: I

skill title: Tecumseh Ratchet Starter Removal

developed & written by: Jim Pitts

visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

You are going to learn:

How to remove the starter main spring housing from a Tecumseh engine.

And in order to do this you will need:

Tecumseh engine with ratchet or impulse starter

Hand Tools

Tecumseh engine service manual

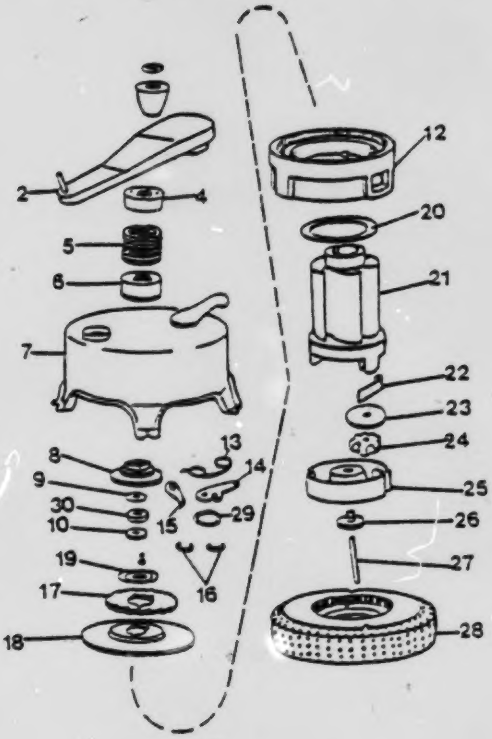
We will know you can do it when:

You have removed and replaced the starter main spring housing from a Tecumseh engine according to service specifications.

INFORMATION

The Tecumseh company uses ten different types of starters. In this module, you are going to learn how to remove and replace the main starter spring housing from a ratchet wind-up starter. If you need to repair one of the other types of starters, refer to the service manual. For the ratchet starters (and some of the others): DO NOT REMOVE THE MAIN SPRING FROM THE HOUSING!!

The picture below will show you the names of the parts and how they fit together. You can refer to it when working on the starter. For more detail see figure TE 13, p. 311, Small Engine Service Manual.



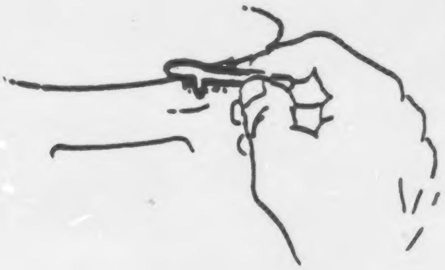
2	Handle
4	Clutch
5	Clutch Spring
6	Bearing
7	Housing
8	Wind Gear
9	Wave Washer
10	Clutch Washer
12	Spring and Housing
13	Release Dog Spring
14	Release Dog
15	Lock Dog
16	Dog Pivot Retainers
17	Release Gear
18	Spring Cover
19	Retaining Ring
20	Hub Washer
21	Starter Hub
22	Starter Dog
23	Brake Washer
24	Brake
25	Retainer
26	Screw(left hand thread)
27	Centering Pin
28	Hub and Screen
29	Spacer Washers
30	Lock Washer

WORD GUIDE

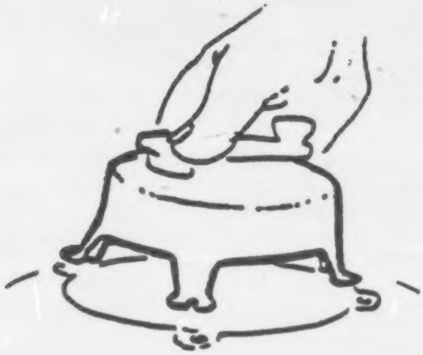
ASSEMBLY - Group of parts working together.

JOB STEPS

1. Take all your equipment and materials to your work area.
2. Move the release lever to the "Release" position to remove the tension from the main spring.

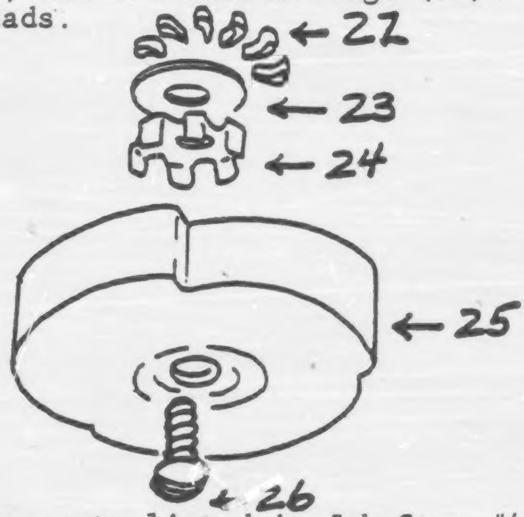


3. Take the bolts out of the starter housing and lift the housing off the engine.

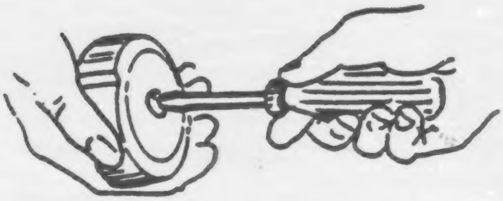


JOB STEPS

4. Find the screw (26) that holds the retainer screen (25), brake (24), brake washer (23), and six starter dogs (22). This screw has LEFT hand threads.



5. Remove the screw and the other parts listed in Job Step #4. Be sure to note the position of the starter dogs in the hub (21).



6. Take off the hub (21), washer (20), spring and housing (12), spring cover (18), release gear (17), and retaining ring (19) as an assembly.

7. Remove the retaining ring and separate the parts. DO NOT REMOVE THE MAIN SPRING FROM THE HOUSING (12). These two parts are replaced as an assembly.

8. Inspect the following parts to see if they are worn out or broken: Main spring and housing, hub and dogs.

JOB STEPS

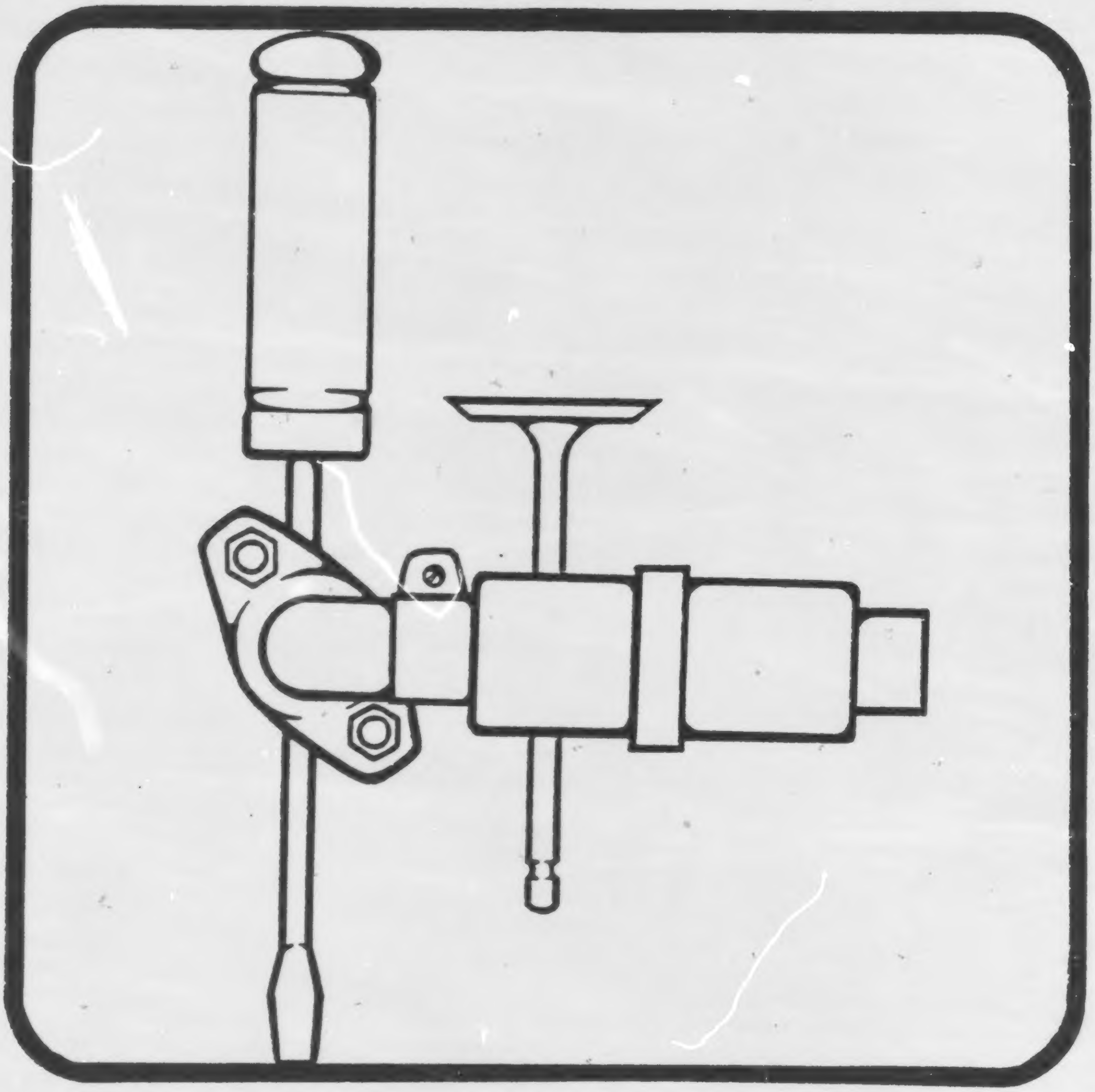
9. Replace any worn or broken parts.

10. Put the starter back together. Follow job steps 3-8 in reverse order (8-3). The picture on the information page will show you how to put the parts together in the right order.

11. Check the fuel level and oil in the engine.

12. Start the engine. Be sure the starter works properly.

13. Ask your instructor to check your work.



small engine repair

unit: STARTERS

capital area career center

module: 7501 03 007 date: January 1978 level: I

skill title: Tecumseh Wind-up Spring Removal (Sure Start)

developed & written by: Jack Helder

visuals by: Dave Wehrwein & Steve Bramer

PEROFRMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to remove the starter main spring housing from a "sure start" Tecumseh engine.

AND IN ORDER TO DO THIS YOU WILL NEED:

Tecumseh engine with a "sure start" starter

Hand tools

Tecumseh engine service manual

Slide tape on Tecumseh Wind-up Spring Removal

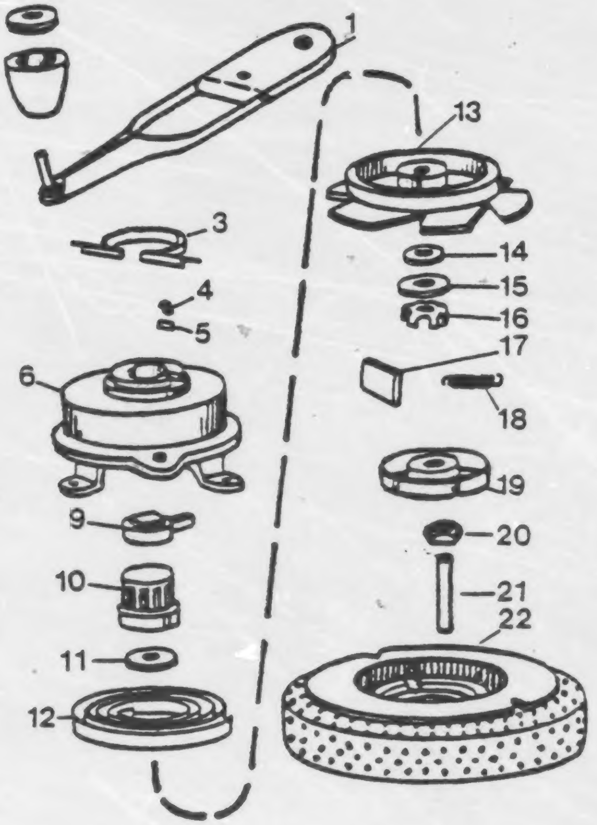
WE WILL KNOW YOU CAN DO IT WHEN:

You have removed and replaced the starter main spring and housing from a Tecumseh "sure start" starter according to service specifications.

INFORMATION

The Tecumseh company uses ten different types of starters. In this module, you are going to learn how to remove and replace the main starter spring and housing from a ratchet wind-up starter called a "sure start". If you need to repair one of the other types of starters, refer to the service manual. The Sure Start Remote Release Impulse Starter is the only kind of ratchet start that has a spring you can remove from the housing. DO NOT REMOVE THE MAIN SPRING ON OTHER KINDS OF STARTERS.

Study the drawing below to learn the parts of a sure start starter. Refer back to this drawing when doing the job steps. Be sure to watch the slide tape before you do this mod.

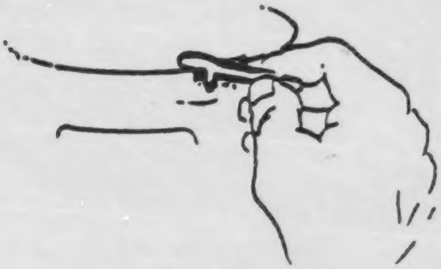


1. Cranking handle
2. Wind dog
3. Brake band
4. Lock dog spring
5. Lock dog
6. Housing
7. Release arm
8. Wave washer
9. Release arm
10. Hub
11. Spacer washer
12. Power spring
13. Spring housing
14. Shim
15. Thrust washer
16. Brake
17. Starter dog
18. Spring
19. Retainer
20. Shoulder nut
21. Centering pin
22. Hub & screen

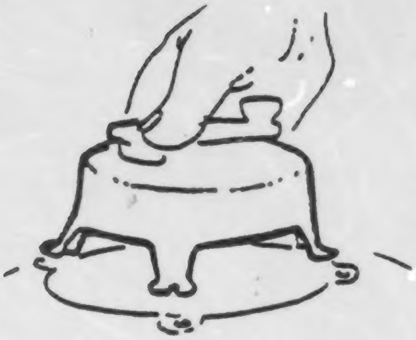
JOB STEPS

1. Take all your equipment and materials to your work area.

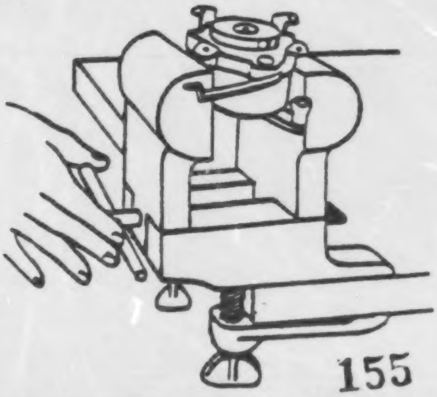
2. Move the release lever to the "Release" position to remove the tension from the main spring.



3. Take the bolts out of the starter housing and lift the housing off the engine.



4. Place the housing in a vise with the cranking handle down.



WORD GUIDE

ASSEMBLY - Group of parts working together.

JOB STEPS

5. Find the centering pin that holds the assembly to the cranking handle. This pin has left hand threads.

6. Remove the centering pin.

7. Remove the shoulder nut (20). Be sure to remember that the shoulder must be down when you later put it back on.

8. Take off the retainer (19), spring (18), starter dogs (17), thrust washer (15) and shim (14).

9. Remove from vise and carefully take out the cranking handle (1), wind dog (2) and brake band (3).

10. Take off housing (6), hub (10) and spacer washer (11).

11. Pull spring (12) from spring housing (13).

NOTE: Look to see how spring end fits into the notch in the spring housing.

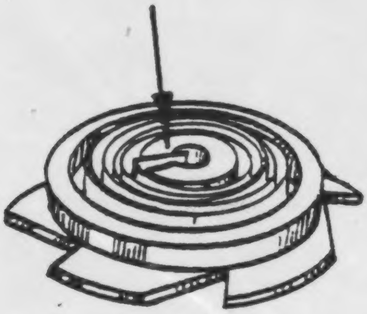
CAUTION: Remember, remove the spring only if your starter is a sure start.

12. Inspect the following parts to see if they are worn out or broken: main spring and housing, hub and dogs.

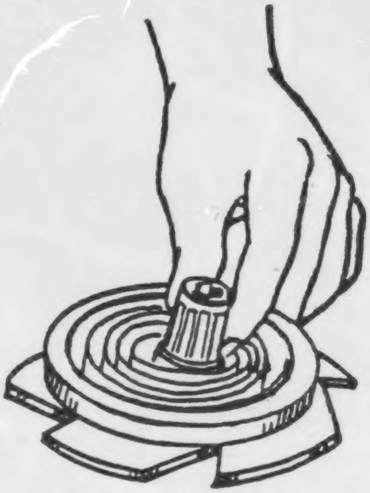
13. Replace any worn or broken parts.

JOB STEPS

14. To replace spring in spring housing, first put the inside end of the spring into the notch in the housing. The housing must be clamped in the vise.



15. Put the hub (10) into the center of the spring.



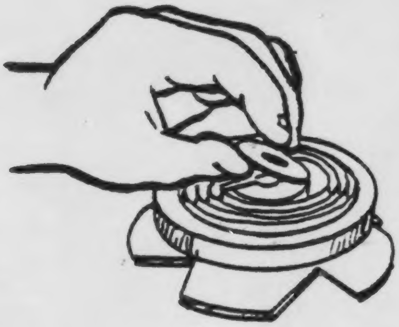
16. Place the cranking handle (1) into the hub and turn it to tighten spring until it fits back into the housing.

NOTE: Push down lightly to keep spring down.

17. Remove handle and hub.

JOB STEPS

18. Put in spacer washer (11), then replace hub.



19. Now replace all parts in reverse order that you removed them in steps 3-8. Remember the slide tape. See your instructor if you have problems.

20. Put the starter back on the engine.

21. Check the fuel level and oil in the engine.

22. Start the engine. Be sure the starter works properly.

23. Ask your instructor to check your work.

small engine repair

unit: Fuel Tanks and Fuel Filters

capital area career center

module: 7501 04 001 **date:** 7/77 **level:** ______

skill title: Removal, Cleaning, and Replacement of Fuel Tanks and Fuel Filters

developed & written by: Anita Flagg

visuals by: Dave Wehrwein

WORD GUIDE

GUNK - Filthy, sticky, or greasy matter.

PERFORMANCE OBJECTIVE

You are going to learn:

How to remove, clean and replace fuel tanks and fuel filters.

And in order to do this you will need:

A 2- or 4-cycle engine

Screwdriver set

Socket set

Open-end wrench set

Flashlight

Safety glasses

We will know you can do this when:

You have removed both the tank and filter, cleaned the dirt, water, rust, gum and gunk and have replaced them securely in their proper positions.

WORD GUIDE

IGNITED - Set on fire.

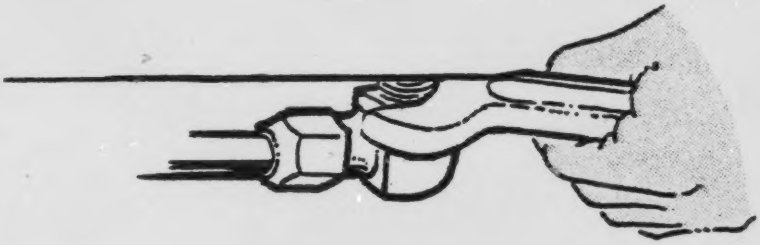
JOB STEPS

1. Take all your equipment to the work area. Wear your safety glasses.

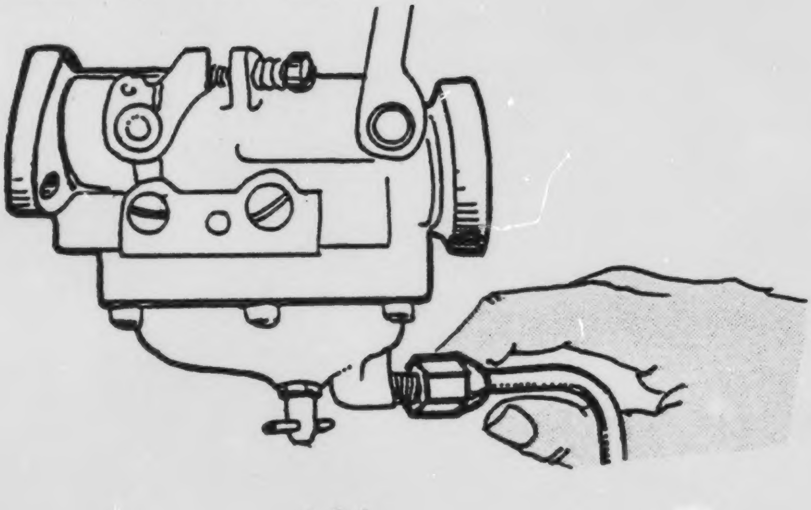
2. Drain any fuel in the tank into a closeable container. On some engines you loosen a drain plug, on others you disconnect the fuel line.

> CAUTION - Do not leave fuel in an open container where it could be ignited accidently.

A. Loosen drain plug.



B. Disconnect the fuel line.

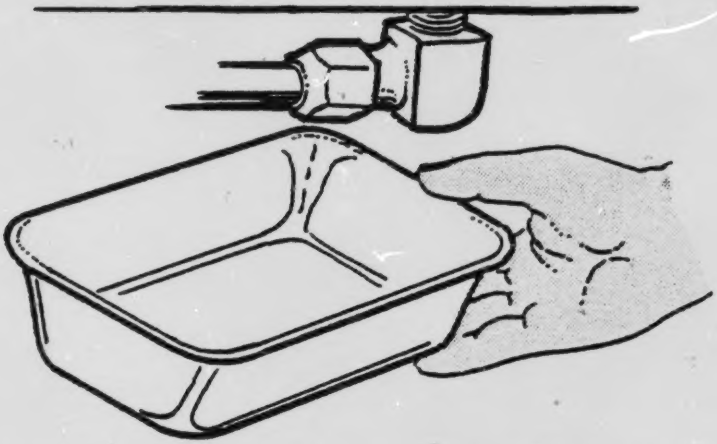


WORD GUIDE

VIBRATION - Shaking or movement.

JOB STEPS

3. Place a drain pan beneath the connector or drain plug to catch the fuel that may drain out.



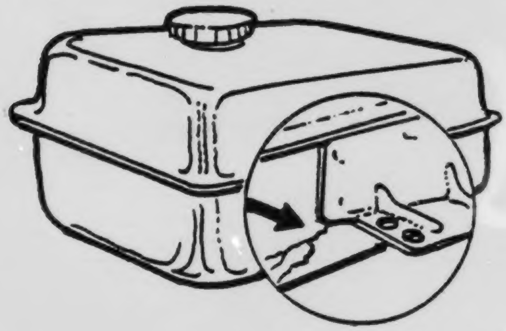
4. Using screwdriver and socket set, loosen the screws and bolts on the fuel tank. Then, carefully remove the fuel tank from its mounting.

5. Check the tank for rust spots, or cracks.

   A. Look closely at the seams where the metal pieces join together.

   B. Look closely around the points where the tank is mounted to its stand or engine.

NOTE: Stress-cracks often are found around these mounting points because of engine vibration.



WORD GUIDE

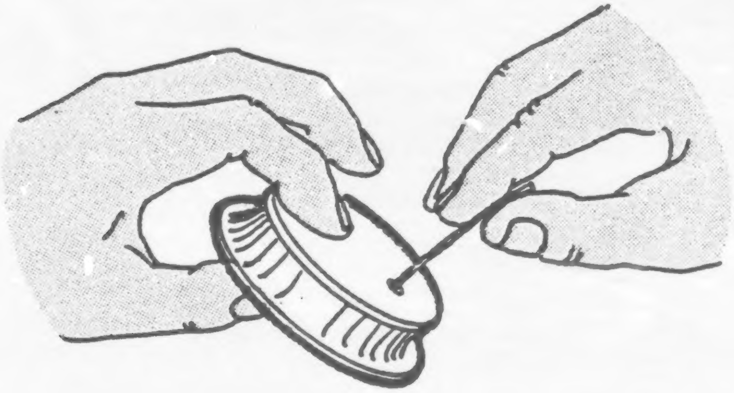
VENT - Small hole.

GUM - Sticky substance.

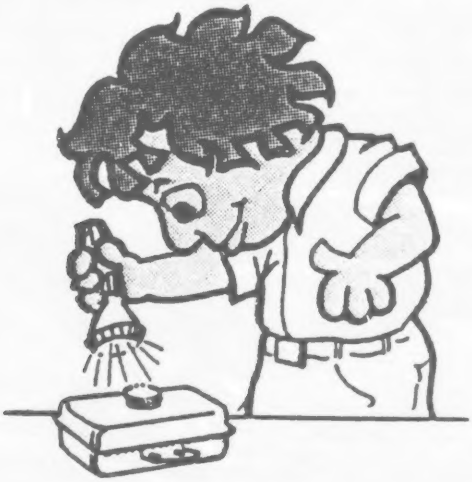
SOLVENT - Type of cleaning fluid.

JOB STEPS

6. Unscrew the fuel tank cap. Look closely at the small hole in its top. If this vent is clogged with dirt, clean it with a small pin or a light blast of air from the air hose.



7. Using flashlight, look into the fuel tank. The inside should be shiny. If there is brown gum or dirt anywhere clean it by rinsing the tank with clean gasoline or a cleaning solvent. Then, blowing it dry with compressed air.

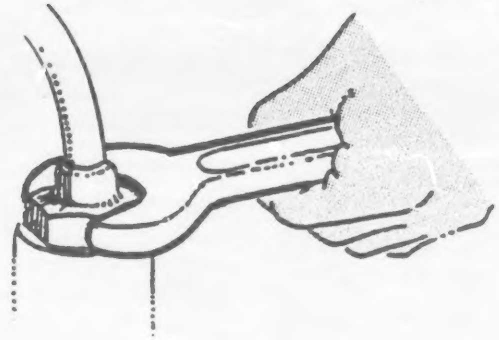


WORD GUIDE

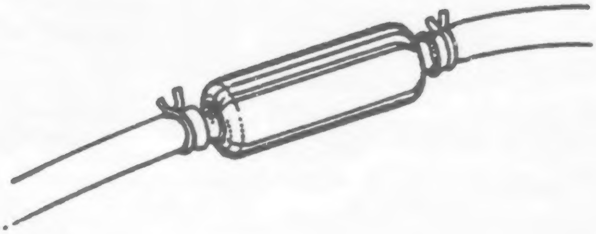
NYLON - White plastic material.

JOB STEPS

8. Using open-end wrench remove the fuel lines from the carburetor body.



9. Remove any in-line fuel filters. These fuel filters are part of the fuel line.



10. Clean the filters by soaking them in clean gasoline or cleaning solvent. Then, blow dry with compressed air.

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CAUTION - Do not soak nylon fuel filters in solvent for more than 25 minutes.

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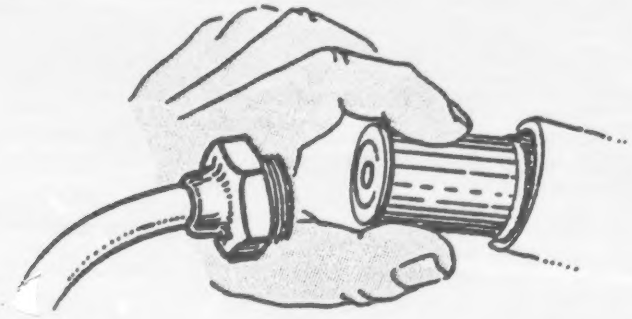
JOB STEPS

11. Unscrew the filter head from the filter body and remove the filter element.



12. Soak the filter element in a cleaning solvent for 30 minutes.

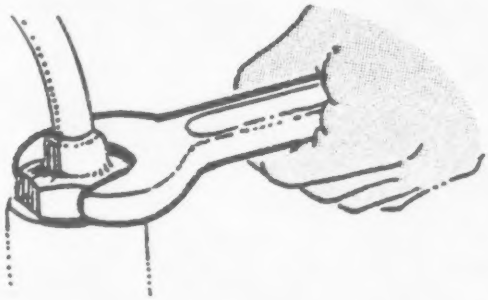
    NOTE: If the in-line filter is made of nylon, or some other plastic material, you usually replace it with a new part because it cannot be disassembled and cleaned.

13. Rinse element in clean gasoline and then blow dry with compressed air.

14. Using open-end wrench set, carefully put the filter assembly back together by:

    A. Placing the filter element into the filter body.

    B. Screwing the filter head onto the filter body.



JOB STEPS

15. Using open-end wrench set, socket set and screwdriver, replace the fuel tank on its mountings, and if the tank is not fastened directly to the carburetor, connect the fuel line.

16. Fill the tank with fuel.

17. Look closely along the seams and around the mounting points for leaks. Also, if the tank has an exterior fuel line, check the fuel line connections.

18. Start the engine to see if the correct amount of fuel is reaching the carburetor. Have your instructor check your work.

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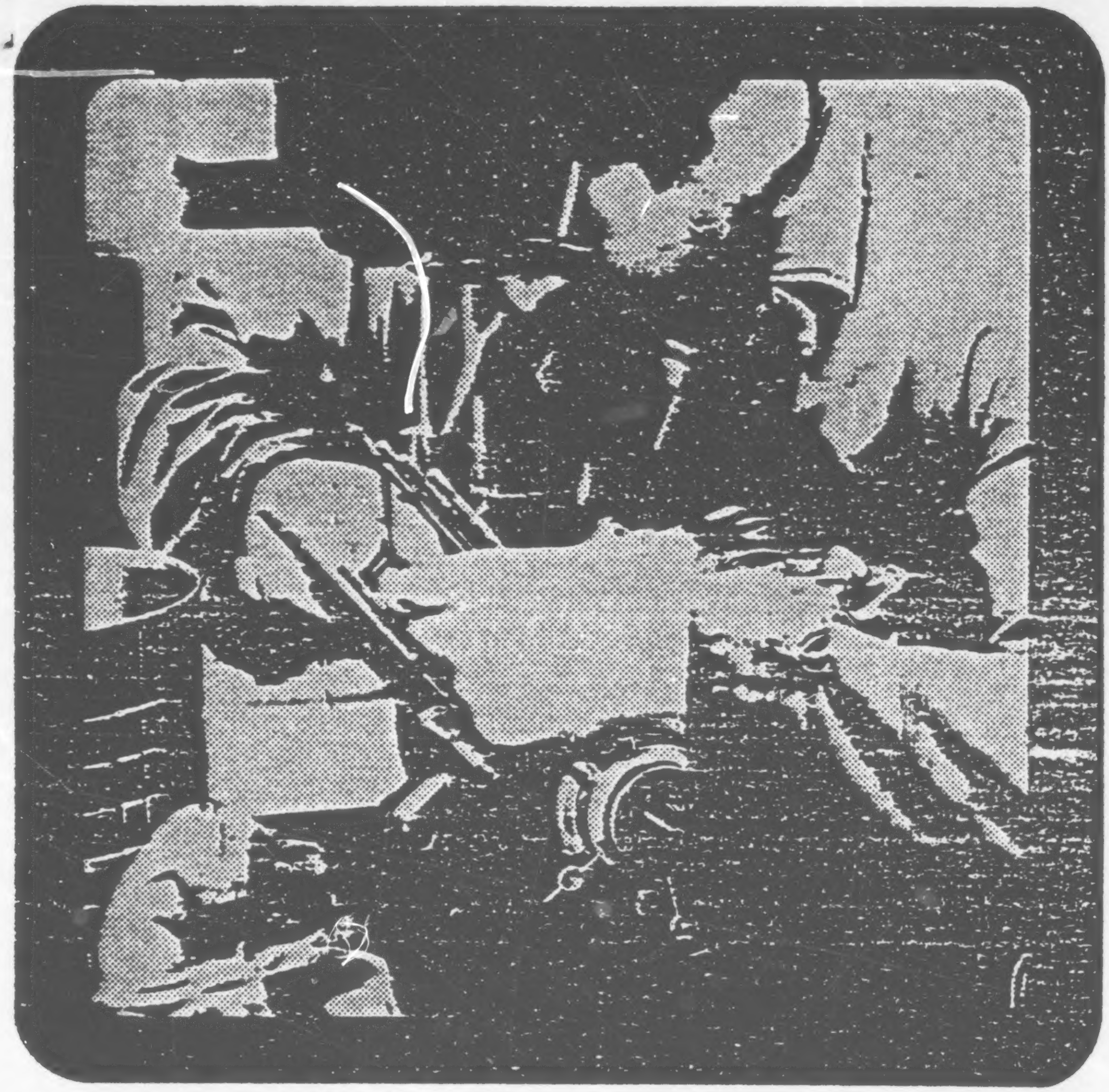


small engine repair

unit: Fuel Tank Lines

capital area career center

module: 7501 04 002 **date:** 4/77 **level:**

skill title: Removal, Replacement, and Checking Fuel Lines for Wear and/or Leaks

developed & written by: Anita Flagg

visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

You are going to learn:

How to remove, replace, and check fuel lines for wear and/or leaks.

What you will need:

A 2 or 4 cycle engine with fuel tanks and fuel lines.

We will know you can do it when:

The fuel lines do not leak and the carburetor receives the correct amount of fuel to smoothly run the engine.

WORD GUIDE

METAL FATIGUE - Breaking or cracking metal parts.

VIBRATION - Shaking.

INFORMATION

Fuel lines are usually made from a plastic material, rubber, metal, or a combination of all three.

A - Plastic or rubber lines are usually flexible and inexpensive to replace but can be affected by very cold or very hot operating conditions.

B - Metal lines are usually not affected by operating conditions. Still, they may crack because of metal fatigue caused by the vibration of the running engine.

It is important that you use the right size line to replace the original. A fuel line too large or too small can affect carburetor performance. A too-long fuel line can interfere with the movement of carburetor linkage or other parts.

NOTE: Refer to engine service manual for size, length, and location of fuel lines.

WORD GUIDE

IGNITED - Set on fire.

JOB STEPS

1. Using open end wrench set loosen the drain plug or disconnect the fuel line.

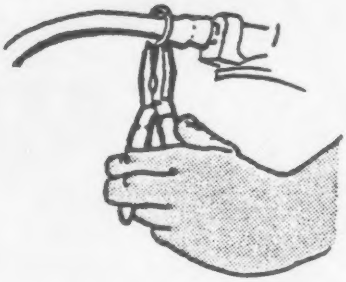
> CAUTION! Do not leave the fuel in an open container where it might be ignited accidentally.

2. Using the screwdriver set and open end wrench set, loosen the fuel line connectors and remove the fuel lines:

   A - running from the tank to the fuel pump and,

   B - running from the fuel pump to the carburetor.

NOTE: Plastic or rubber lines may be held in place by hose clamps. Loosen these clamps before pulling the lines away from the metal nipple.

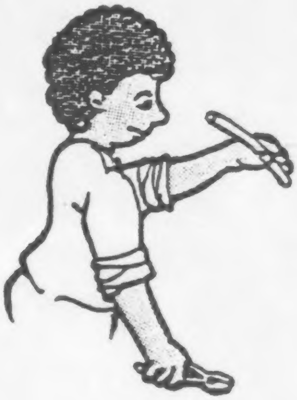


WORD GUIDE

ROUTE - The path a line follows.

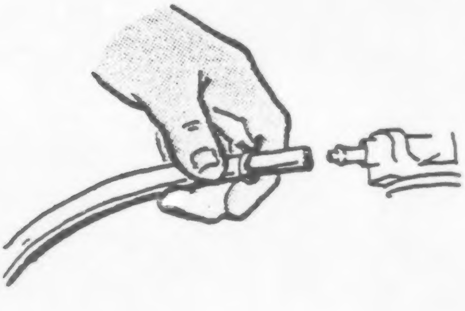
JOB STEPS

3. Look closely at the lines to check for cracks and splits. Cracks most often occur where the lines curve or are bent around other parts. Plastic or rubber lines often split where they are fitted to the metal nipple.



4. Before replacing a metal fuel line, refer to the engine service manual to check the proper route of that line. Then, fit the new line by carefully making the bends and curves before connecting the ends to the tank, pump, or carburetor.

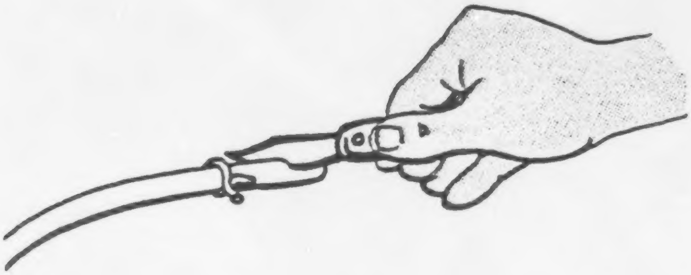
NOTE: Before replacing a plastic or rubber line, check the engine service manual for the correct diameter and length. Then, replace the line.



JOB STEPS

5. Using a knife, cut the ends of the new rubber or plastic lines so the ends are even. Level ends will fit tightly against the metal nipple shank and will prevent leaks.

   NOTE: If the lines are held on with clamps, be sure to fit the clamps over the ends of the lines before fitting the lines to the nipples.



6. Using screwdriver set and open end wrench set, carefully tighten the connectors or clamps for a snug fit.

7. Fill the tank half full of fuel and then start the engine.

8. Look closely for leaks at the connectors. Then, re-check the routed fuel line to make sure it will not rub against moving parts or interfere with their action.

small engine repair

unit: Fuel Pumps and Fuel Filters

capital area career center

module: 7501 04 003 date: 4/77 level:

skill title: Removing, Replacing, and Rebuilding Fuel Pumps; Cleaning and Servicing Sediment Bowls.

developed & written by: Anita Flagg

visuals by:

WORD GUIDE

EXTERIOR - Outside

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to remove, rebuild, and replace fuel pumps, and clean and service sediment bowls.

AND IN ORDER TO DO THIS YOU WILL NEED:

A 2- or 4-cycle engine with an exterior fuel pump

Screwdriver set

Socket set

Open end wrench set

Safety glasses

WE WILL KNOW YOU CAN DO IT WHEN:

Clean fuel reaches the carburetor in the correct amount and there are no fuel or oil leaks.

WORD GUIDE

IMPULSE - Movement caused by a change in pressure.

VACUUM PRESSURE - Suction

SEDIMENT BOWL - Container that cleans the fuel.

INFORMATION

There are three types of fuel pumps; electrical, impulse, and mechanical. This mod deals only with the mechanical type pump.

Basically, the only difference between the three types of pumps is the way in which they are run. The electrical is run by electricity; the impulse, by vacuum pressure; and the mechanical pump by mechanical action.

The function of a fuel pump is to pull the fuel from the fuel tank and push it into the carburetor in the correct amount. Too much fuel would flood the engine; too little fuel will starve the engine.

When possible, use the factory service handbook as a guide to repairing the type of pump on which you are working.

Sediment bowls trap dirt, grit and other particles that may get into the fuel.

WORD GUIDE

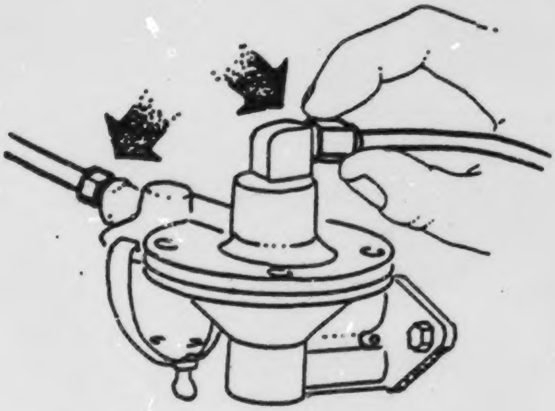
IGNITED - Something which is set afire is ignited.

JOB STEPS

1. Drain the fuel tank by loosening the drain plug or disconnecting the fuel line. Wear your safety glasses.

CAUTION - Do not leave fuel in an open container where it could be accidently ignited.

2. Disconnect the fuel lines by loosening the fuel line connectors on the pump.



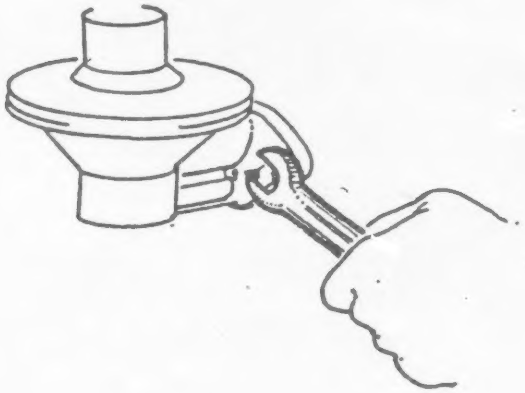
3. Place a drain pan under the pump to catch any fuel draining from the lines or pump.

WORD GUIDE

YOKE ASSEMBLY - A "U"-shaped connector.

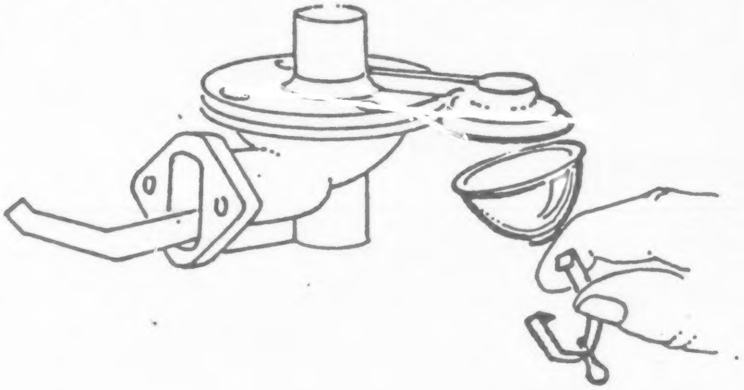
JOB STEPS

4. Disconnect the fuel pump from its mounting.



NOTE: Often, the sediment bowl and fuel pump will be one unit. When you remove the pump for service and cleaning, you should also service and clean the bowl.

5. By carefully loosening the set screw which holds the yoke assembly in place, remove the sediment bowl.



WORD GUIDE

DIAPHRAM - Cloth or rubber sheet that divides two areas or parts.

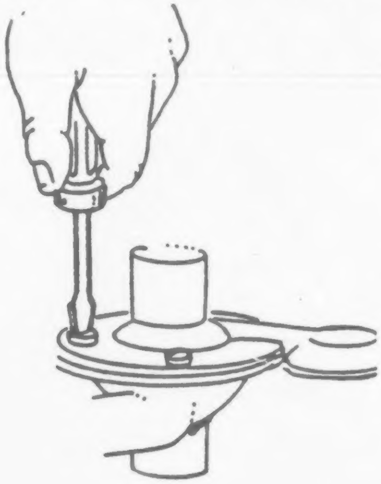
JOB STEPS

6. Check the two gaskets that seal the bowl for cracks or tears and, if necessary, replace them.

7. Clean the screen, bowl and pump valves by soaking them in a cleaning solution or in clean gasoline for 30 minutes.

8. Using light blasts of compressed air, blow them dry.

9. Separate the upper part of the pump body from the lower part by loosening the proper screws or bolts.



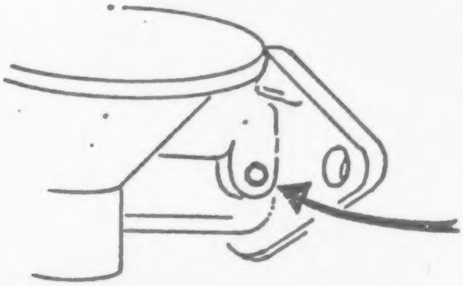
10. With the two halves separated, remove the gasket and pump valve.

CAUTION - Do not pull up on the diaphram. It is still connected to the pump lever.

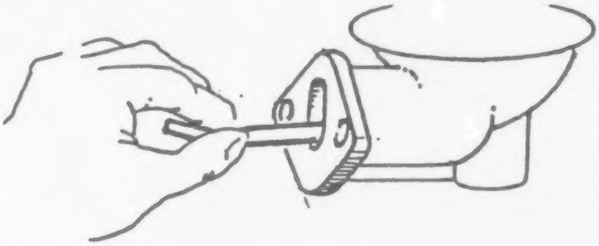
JOB STEPS

11. Clean the pump valve, follow Job Step 6.

12. To remove the diaphram, use a hammer and small drift pin to carefully drive the lever pin out of its socket.



13. Press against the diaphram with your thumb and remove the pump lever.



JOB STEPS

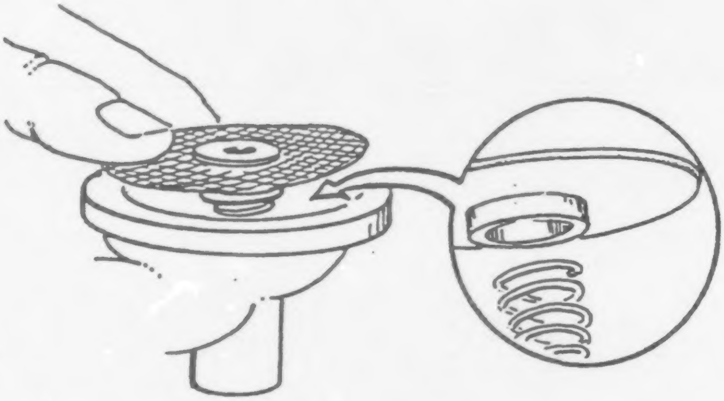
14. Now the diaphram, diaphram spring, pump lever and lever spring may now be removed.

15. Replace the diaphram with a new one.

16. Replace all used parts, (diaphram, diaphram spring, lever spring), with supplies from the fuel pump repair kit.

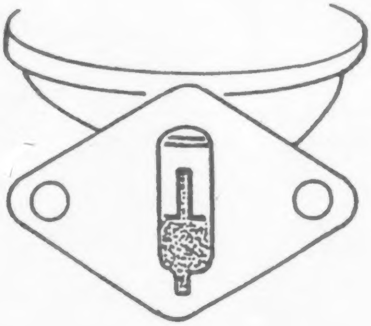
17. Reassemble the pump, by placing the diaphram spring into its hole in the lower pump body.

18. Place the diaphram on the spring, making sure the spring enters the cup on the bottom of the diaphram.

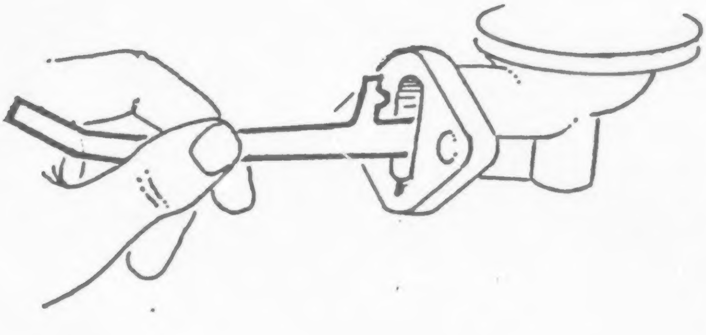


JOB STEPS

19. When you've put the spring and diaphram in place, look through the pump lever opening. Then, push down on the diaphram and turn it until you can see the slot on the shaft.



20. Put the hooked end of the pump lever through the slot.

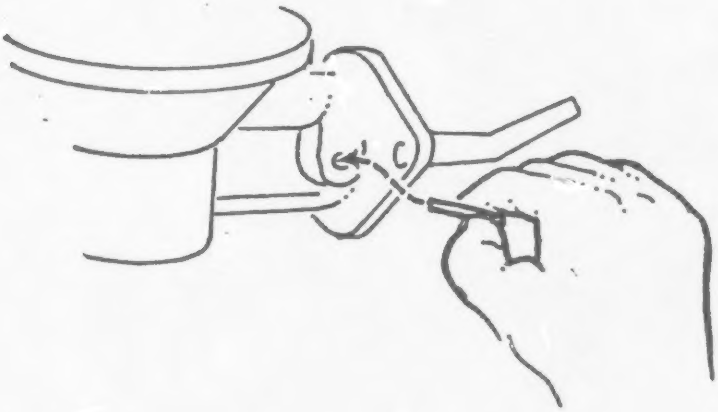


WORD GUIDE

COMPRESS - Push together or push down.

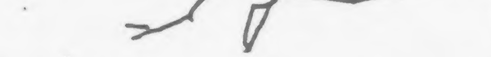
JOB STEPS

21. Line up the lever-pin holes in the pump-lever arm and the pump body and then carefully drive the lever-pin back into place.



22. Put the lever-spring on the lever-spring pin.

23. Using a screwdriver to compress it, push the lever-spring down until the arm on the pump-lever can be lifted to hold the spring in place.



NOTE: Work the pump lever up and down to check its action.

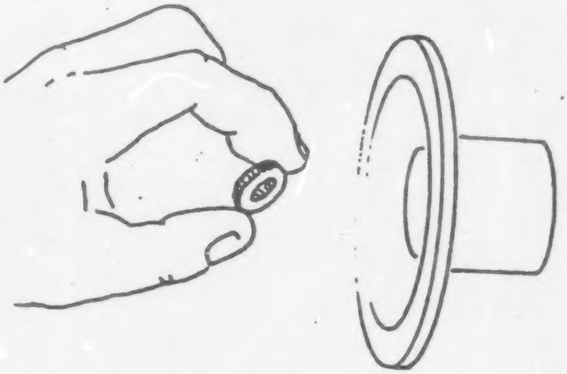
JOB STEPS

24. Replace the pump valve and gasket in the upper pump body.

25. Place the upper pump body half on the lower half and line up the holes for the screws or bolts that hold the two halves together.

26. Place the screws or bolts in the holes. While tightening them, push down on the pump lever as shown in the illustration.

27. Replace the pump valve and gasket in the sediment bowl body.



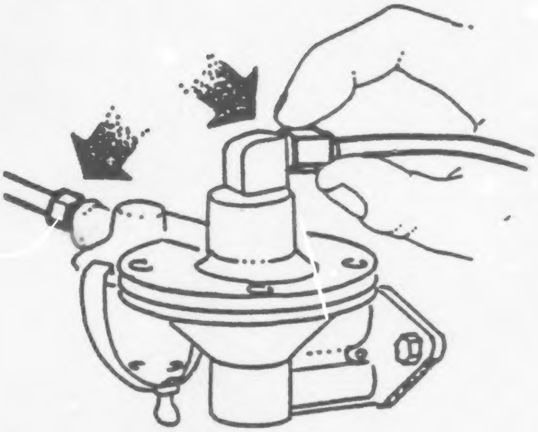
28. Place the filter screen and gasket atop the sediment bowl.

29. Hold the bowl in place while carefully tightening the set screw on the yoke assembly.

30. Grease the bottom edge of the pump lever and mount the pump on the engine.

JOB STEPS

31. Re-connect the fuel lines, one from the tank, the other to the carburetor.



32. Fill the tank to half with fuel.

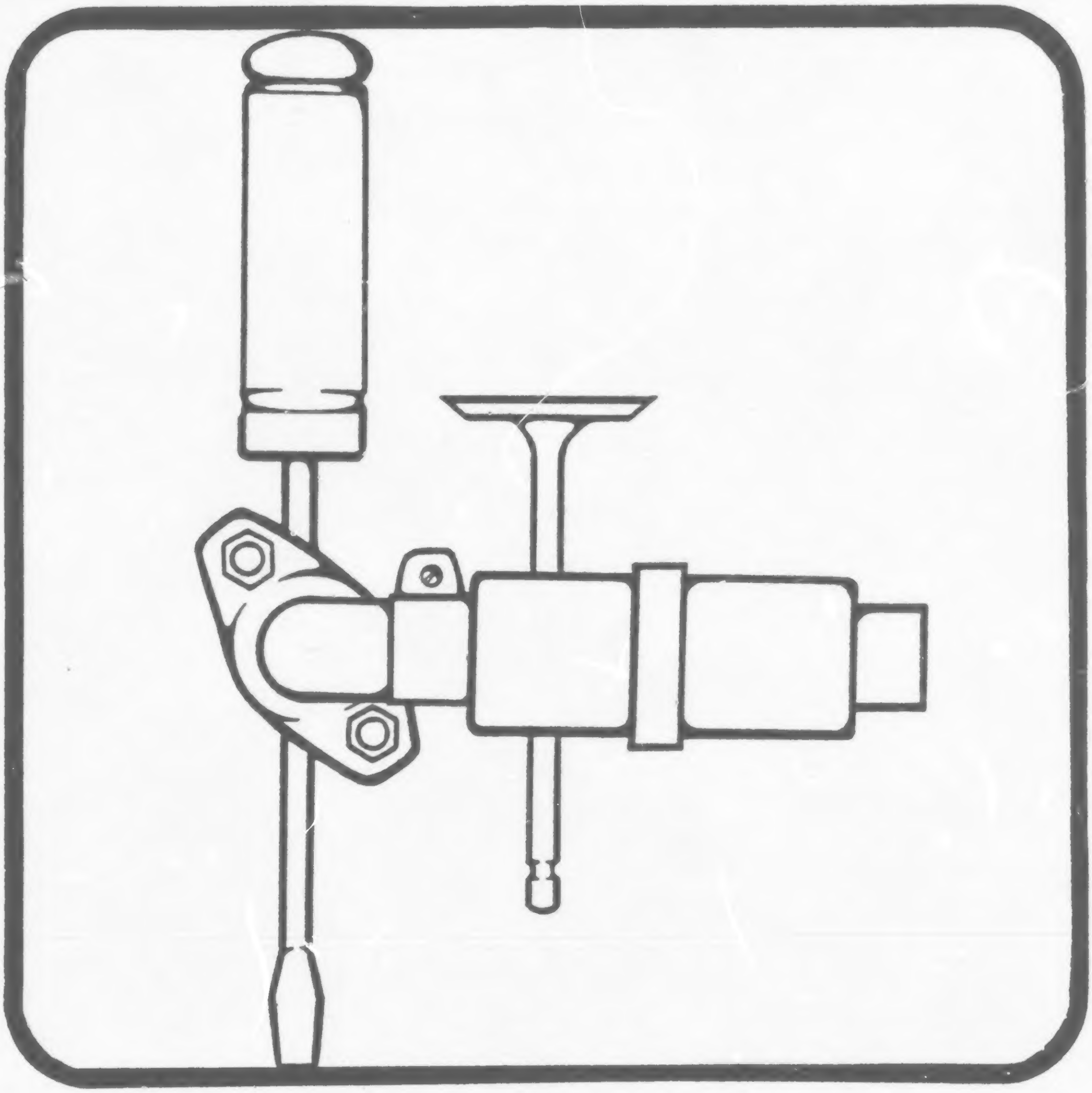
    NOTE: Remember to replace the drain plug.

33. Start the engine. While the engine is running, look closely near the connectors and gaskets to check for gasoline leaks.

34. Look closely around the fuel pump mount to check for oil leaks.

35. If there are no fuel or oil leaks, and the engine runs smoothly, you have completed the job.

36. Put away all equipment.



small engine repair

unit: CARBURETOR

capital area career center

module: 7501 05 001 date: July 1977 level: I

skill title: Carburetor Overhaul (Bowl-Float Type)

developed & written by: Jim Pitts

visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

You are going to learn:

How to overhaul bowl-float type carburetors used on a 2-cycle engine.

And in order to do this you will need:

A bowl-float type carburetor

Feeler gauge

Hand tools

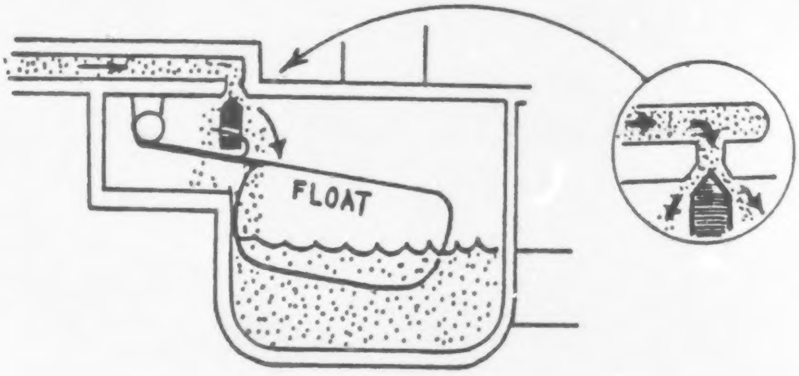
Service manual for the kinds of carburetors you are going to overhaul

We will know that you can do it when:

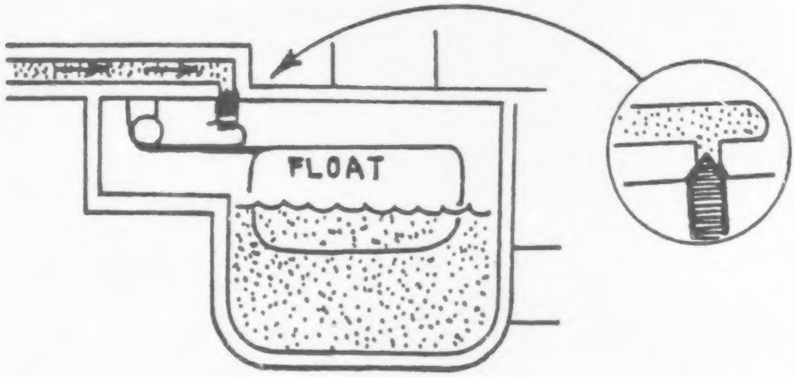
You overhaul the carburetor according to service specifications so that it works properly on the engine.

INFORMATION

Another name for a bowl-type carburetor is a float-type carburetor. In a bowl-type carburetor, fuel flows into the carburetor by force of gravity. The fuel tank is above the carburetor. Fuel flows into the inlet valve.

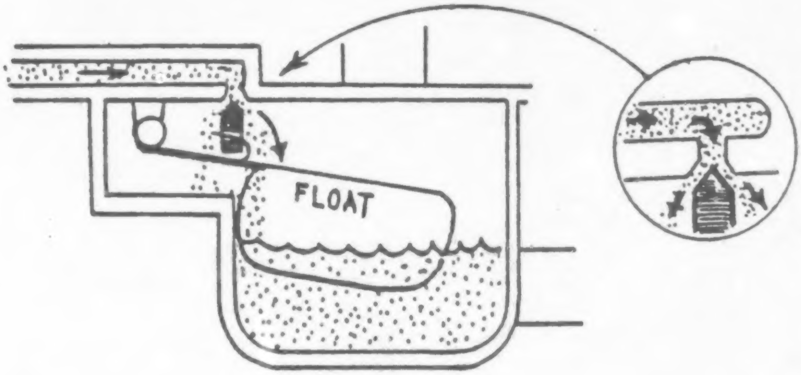


When the bowl is full, the float lifts and closes the valve.

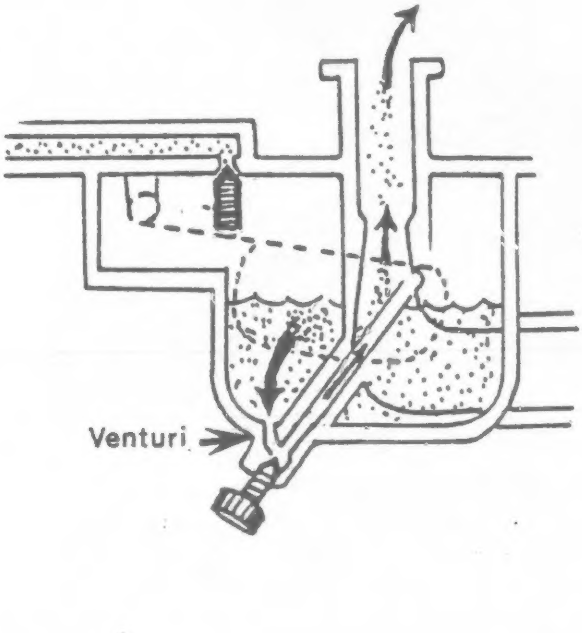


INFORMATION

When the engine runs, it uses the fuel. Then, the float drops and more fuel comes into the bowl from the tank.

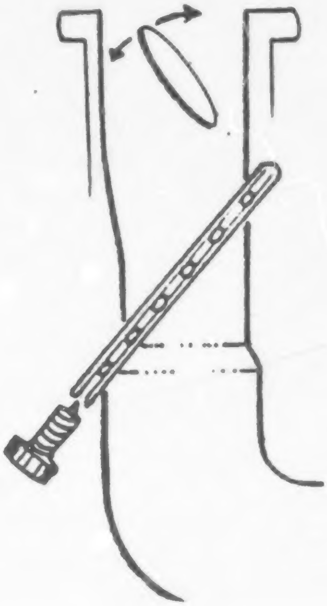


Fuel gets into the engine through a vacuum (suction). The vacuum is created when the piston goes down as the intake valve opens. The "venturi" (the narrow part in the carburetor) moves the air faster by creating stronger suction.

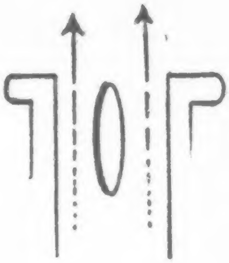


INFORMATION

The throttle plate controls the amount of air that goes into the engine. A small amount of air and fuel goes into the engine when the throttle plate is closed.



When the throttle plate is open, a great deal of air and fuel goes into the engine.



INFORMATION

There are many kinds of bowl-type carburetors for 2-cycle engines. Some of them are; Briggs & Stratton, Tillotson, Clinton, Carter, Bendix, Stromberg, Lawnboy, Pioneer and Tecumseh. You will need a service manual for the kind of carburetor you have to service.

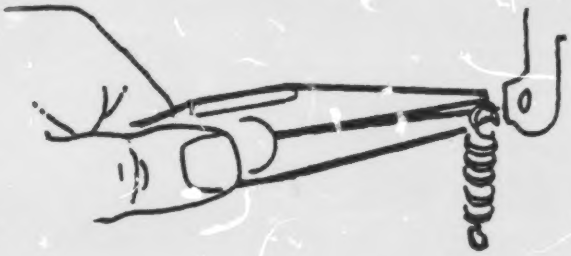
This module shows how to service a bowl-type carburetor for a Briggs & Stratton, 2-cycle engine. If you have a different engine, read its service manual.

JOB STEPS

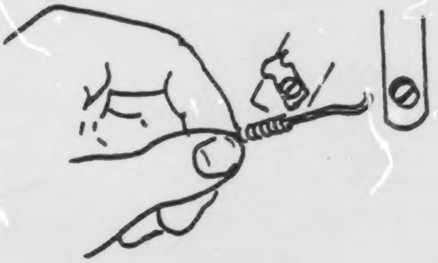
1. Get your equipment and take it to your work area.

2. Remove the carburetor from the engine.

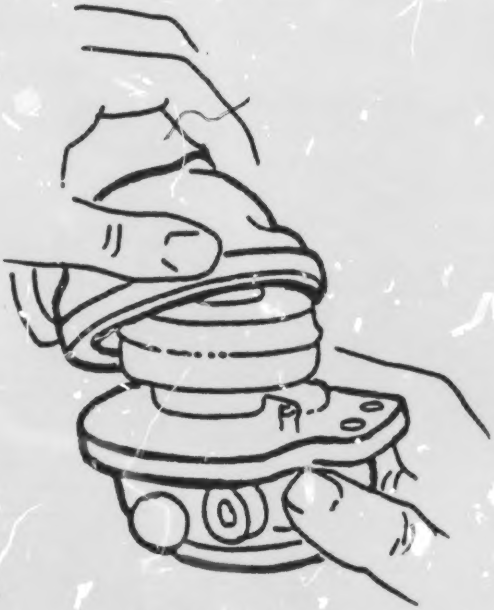
3. Take off the governor control link and spring with needlenose pliers



4. Take off the throttle and choke linkage.

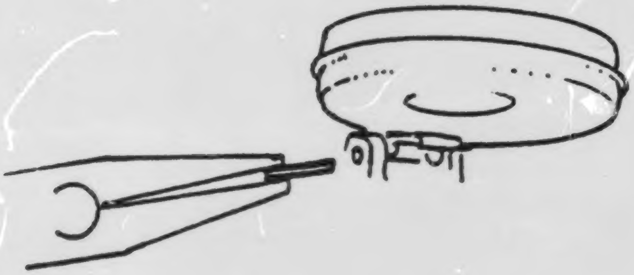


5. Take off the bowl from the body of the carburetor and take the top off the bowl.

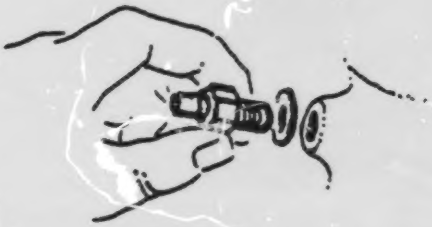


JOB STEPS

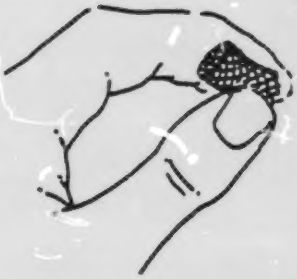
6. Take the float hinge pins, float and needle valve out of the bowl.



7. Take the inlet seat and gasket out of the bowl.



8. If the inlet has a filter screen, take it out.

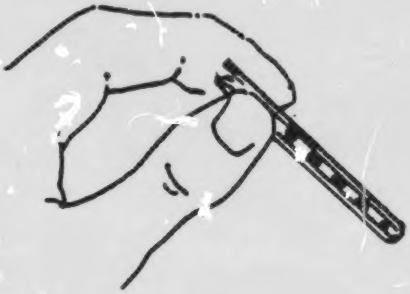


9. Put all metal parts in the carburetor cleaner for 5 to 10 minutes.

10. Use an air gun to blow dirt and cleaner off all parts.

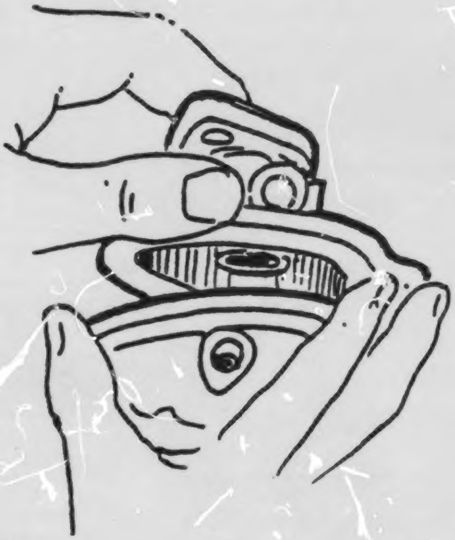
JOB STEPS

11. Take the adjusting needles out of the carburetor body. Remove any linkage or other parts from the body of the carburetor.



12. Remove the main nozzle.

13. Take the upper body off of the lower body.

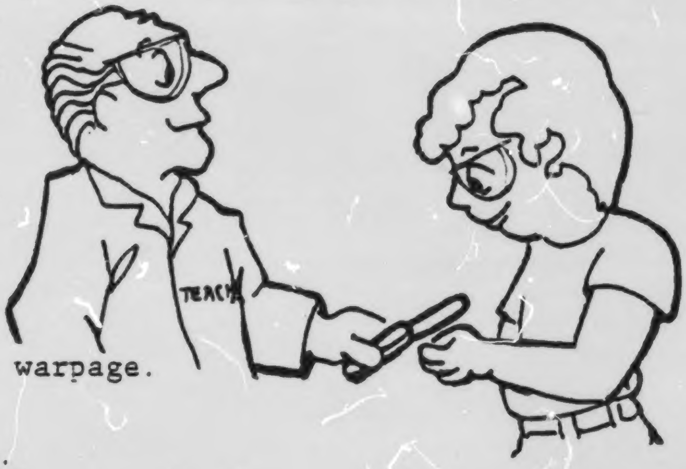


14. Put the body of the carburetor in the cleaner for 5 to 10 minutes.

15. Blow and wipe the dirt and cleaner from the carburetor body.

JOB STEPS

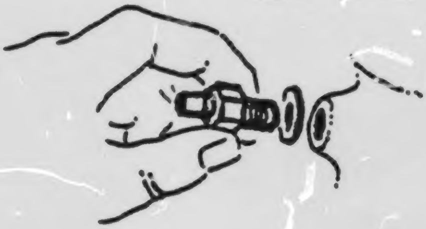
16. Check the throttle shaft and bushings for wear. Have the instructor show you how to use a feeler gauge to do this.



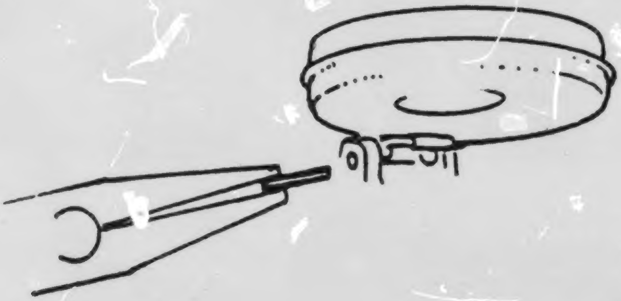
17. Check the upper body for warpage.

18. Put in the filter screen.

19. Put in a new inlet seat and gasket, if you have one.

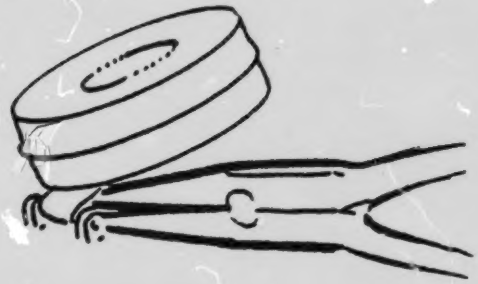


20. Put in the needle valve, float and float hinge pin.



JOB STEPS

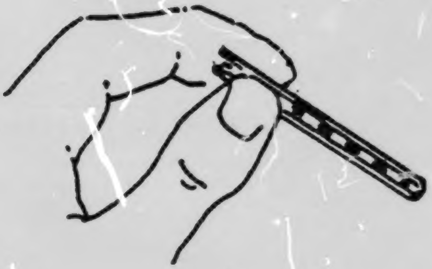
21. Adjust the float level. Check the service manual for the kind of carburetor you have. Bend the float (tang) to adjust the float.



22. Put the upper and lower bodies back together.

23. Put in the main nozzle.

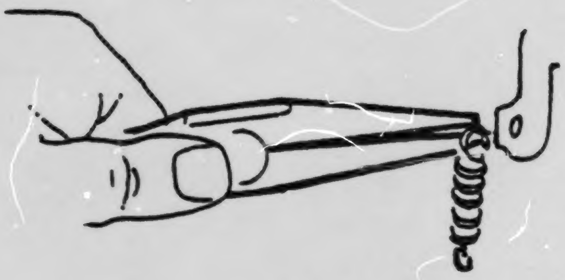
24. Put the new adjusting needles and gaskets in the carburetor, if you have them.

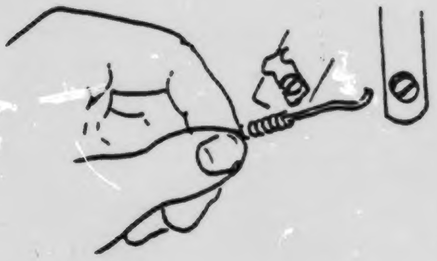


25. Put the bowl on the main body.

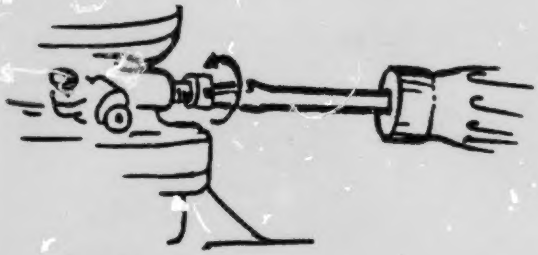
JOB STEPS

26. Put on the choke, throttle and governor link, and governor spring.

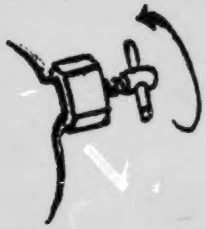




27. Turn the idle needle all the way in and then back it off 3/4 of a turn.



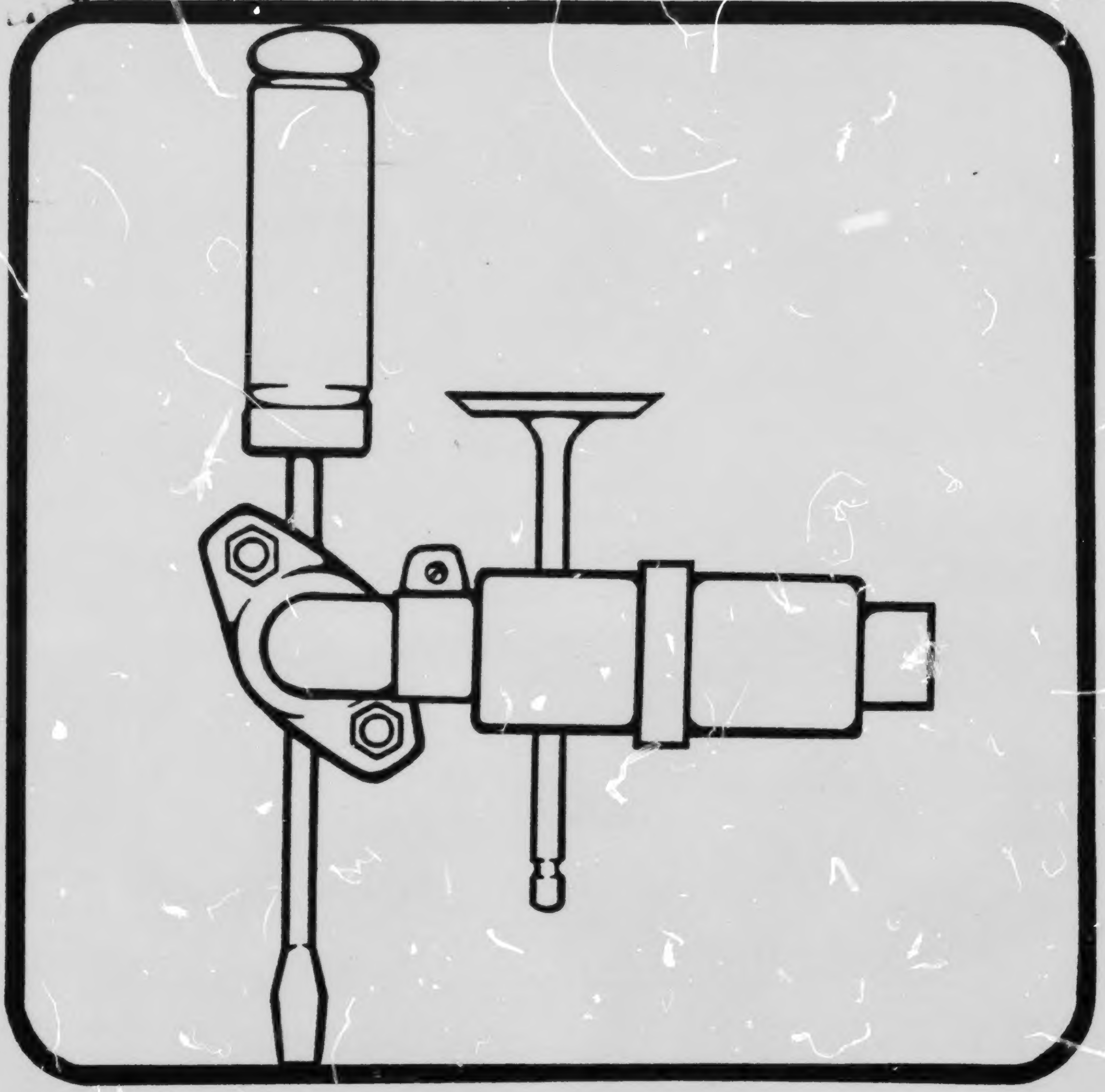
28. Turn the power needle all the way in and then back it off 1 1/2 turns.



These two steps will let the engine start and run. After it is running, follow the steps in module 7501 05 007.

29. Put the carburetor back on the engine.

30. Get your instructor, start the engine. Adjust the carburetor by following the steps in module 7501 05 007.



small engine repair

unit: CARBURETOR

capital area career center

module: 7501 05 002 date: February 1978 level: I

skill title: Carburetor Overhaul - Diaphragm Type

developed & written by: Jim Pitts

visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to overhaul a diaphragm type carburetor.

AND IN ORDER TO DO THIS YOU WILL NEED:

Diaphragm type carburetor

Hand tools

Specification manual for this kind of carburetor

Epoxy

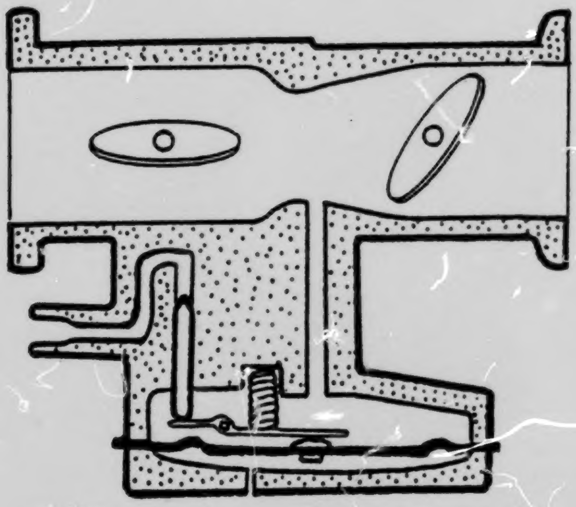
Safety glasses

WE WILL KNOW YOU CAN DO IT WHEN:

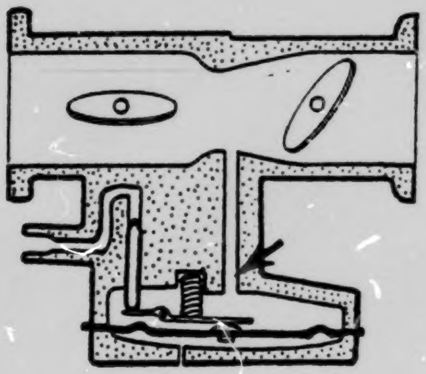
You have overhauled the carburetor according to service specifications so that it can be adjusted to idle and accelerate to top speed without hesitating when the throttle is opened.

INFORMATION

In a diaphragm type carburetor, fuel gets to the carburetor by gravity or through a fuel pump. Atmosphere pressure is on the low side of the diaphragm (through a vent hole).

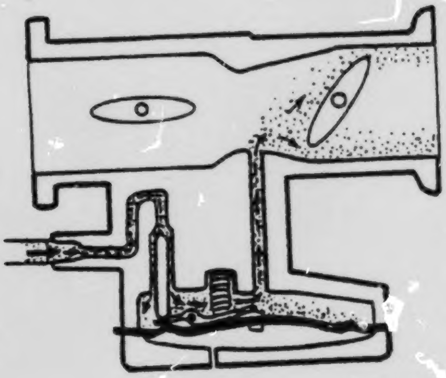


When the engine is running, there is a vacuum above the diaphragm through the nozzle channel.

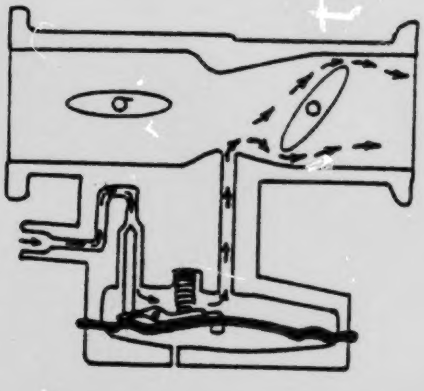


INFORMATION

This great pressure on the low side of the diaphragm pushes up the diaphragm and shoves up the inlet valve. The diaphragm is open so fuel can go into the carburetor.



When the engine is running, vacuum draws the fuel through the opening and into the engine. The throttle plate must be at least partly open.



WORD GUIDE

RICH - High in burnable materials, low in oxygen.

LEAN - Low in fuel, high in oxygen.

INFORMATION

When the engine is cold, the choke is closed and less air gets into the venturi. This makes the air fuel mixture rich. When the engine warms up, the choke is open. This lets more air into the venturi and the air fuel mixture is lean.

There are many kinds of diaphragm type carburetors. Some of them are Tillotson, Walbro, McCulloch and Pineor. In this module, we will use a Tecumseh carburetor.

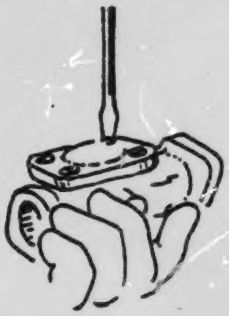
WORD GUIDE

FLAKE-OFF - Small pieces breaking off a part.

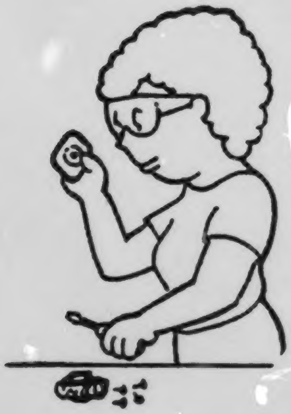
DISTORTION - Something with odd, unusual or unwanted shape.

JOB STEPS

1. Take all equipment and materials to your work area. Wear your safety glasses.
2. Remove the carburetor from the engine.
3. Remove the diaphragm cover screws.

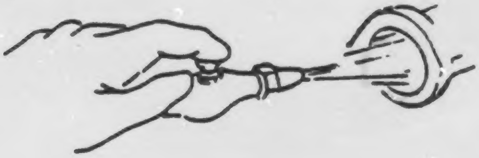


4. Check the diaphragm for wrinkles, flake-off, or distortion.

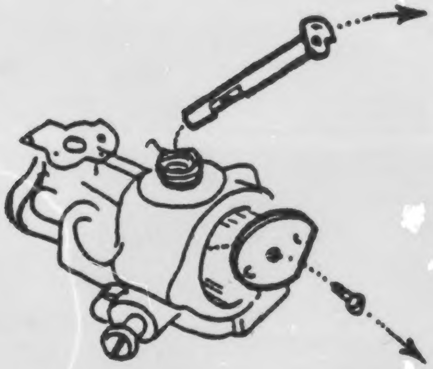


JOB STEPS

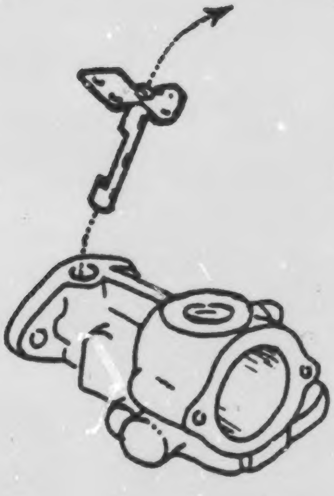
5. Clean high, middle and low speed air flows.



6. Remove the choke shaft and plate and clean all surfaces.



7. Remove the throttle shaft and clean it.



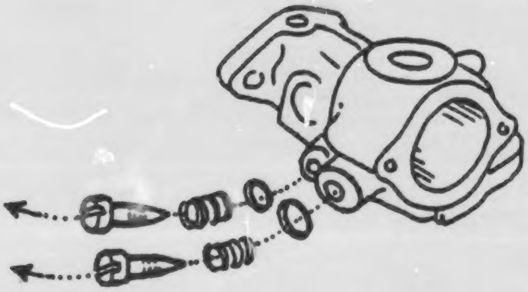
WORD GUIDE

REPLACE - Put back.

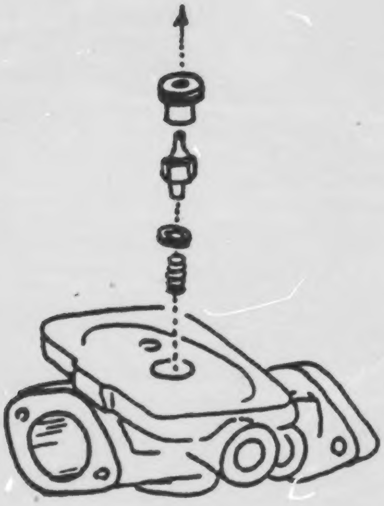
JOB STEPS

8. Check the throttle shaft and bushings for wear.

9. Remove the main and idle fuel needle. Clean the jets.



10. Remove the inlet lever, needle, and hinge pin. Clean these parts.

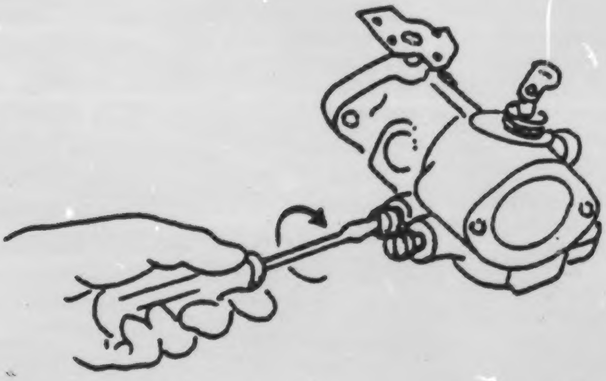


JOB STEPS

11. Replace the parts you took off in steps 6-10. Do it in reverse order from how you took them off.

12. Replace the diaphragm and diaphragm cover. Use a new diaphragm, if the old one is worn out.

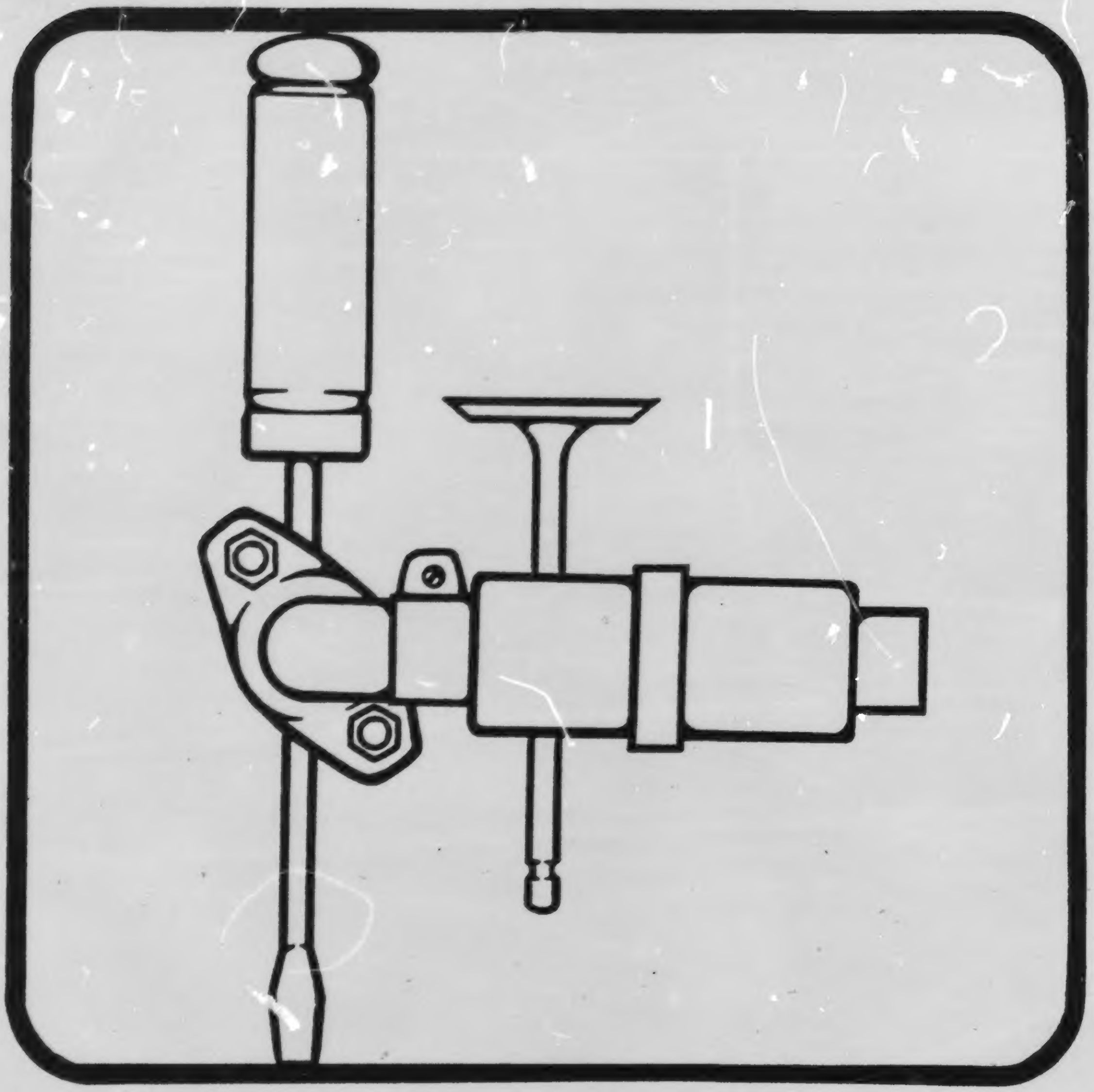
13. Adjust the idle fuel needle by turning it in all the way. Then back it out 3/4 turn.



14. To adjust the main fuel needle, turn it in all the way. Back it out 1 turn.

15. Put the carburetor back onto the engine.

16. Get your instructor. Start the engine. Adjust the carburetor by following the steps in module 7501 05 007.



small engine repair

unit: CARBURETOR

capital area career center

module: 7501 05 003 date: December 1977 level: ____

skill title: Carburetor Overhaul (Sliding Valve)

developed & written by: Don Foster

visuals by: Steve Bramer

WORD GUIDE

DISASSEMBLE - Take apart

REASSEMBLE - Put together

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to disassemble, clean, repair or replace worn parts and reassemble.

IN ORDER TO DO THIS YOU WILL NEED:

A sliding valve carburetor
Wrenches
Screwdrivers
Service manual
Safety glasses

WE WILL KNOW YOU CAN DO IT WHEN:

1. All parts will be placed in their proper place according to the service manual.
2. The carburetor properly meters fuel at high and low speeds.
3. You disassemble and assemble the carburetor in 1 1/2 hour.

WORD GUIDE

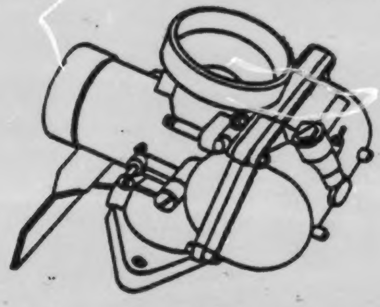
FUEL TAP - A valve that is used to control the flow of fuel

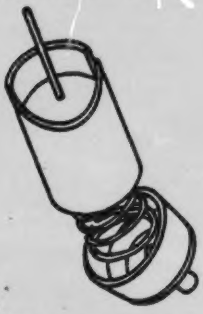
JET - A small hole or needle that funnels the fuel into a streamer or spray

JOB STEPS

1. Close fuel tap and remove air cleaners. Wear your safety glasses.

2. Remove mixing chamber cap holder and pull from carburetor together with throttle valve, jet needles and jet needle clips.



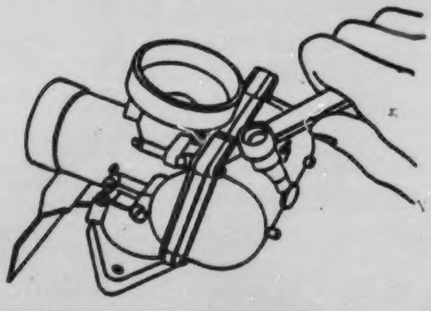


3. Inspect the throttle valve slide for excessive scoring at the front area and check the extent of wear on the rear slide face. If wear is apparent, the slide should be renewed.

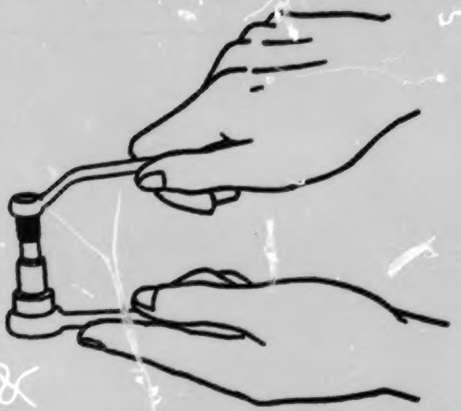
4. Inspect the throttle return spring for loss of "springiness". Replace if in doubt.

5. Check the needle jet for wear or possible scratches, especially the tapered end.

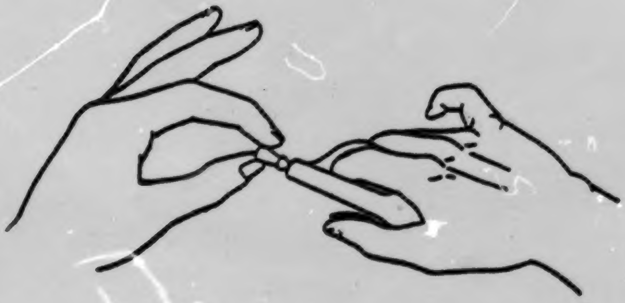
6. Next, remove the main jet holder.



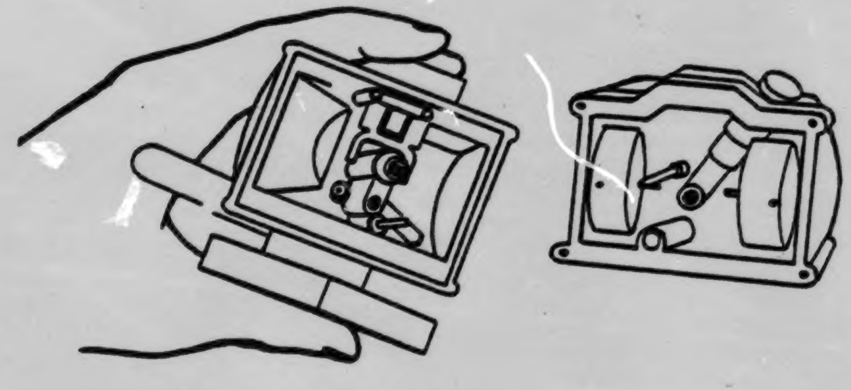
7. And, then remove the main jet from its holder.



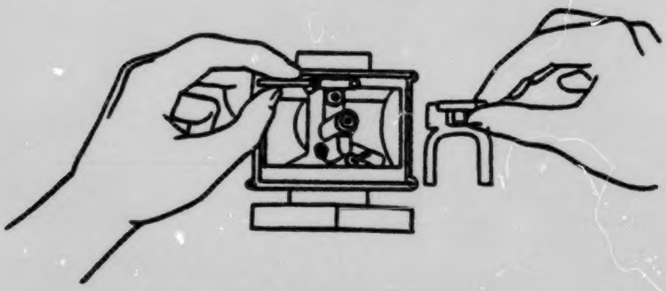
8. Clean the jets by blowing with compressed air. Never use wire or any other type of tool to clear passage way.



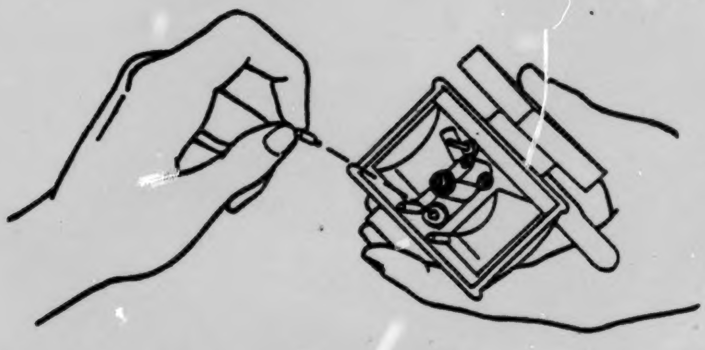
9. Remove bowl cover screws. Tap the bowl to break it loose from the gasket.



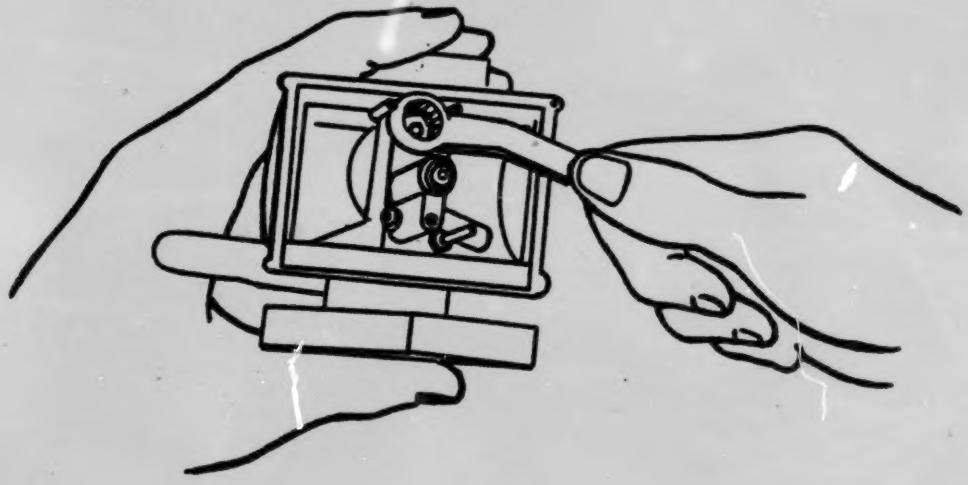
10. Withdraw float lever pin and float lever.



11. Remove float needle.

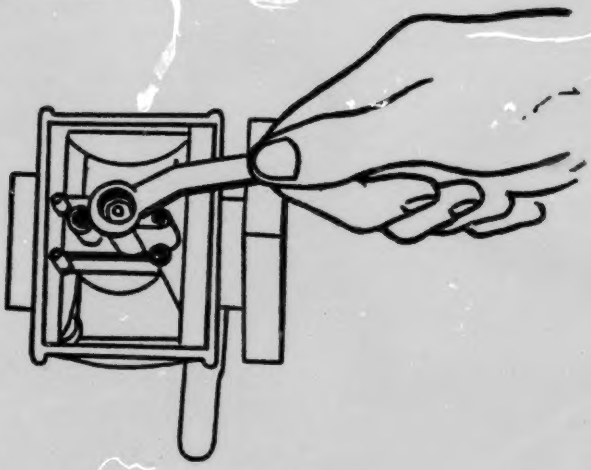


12. Remove float needle seat with small metric wrench.

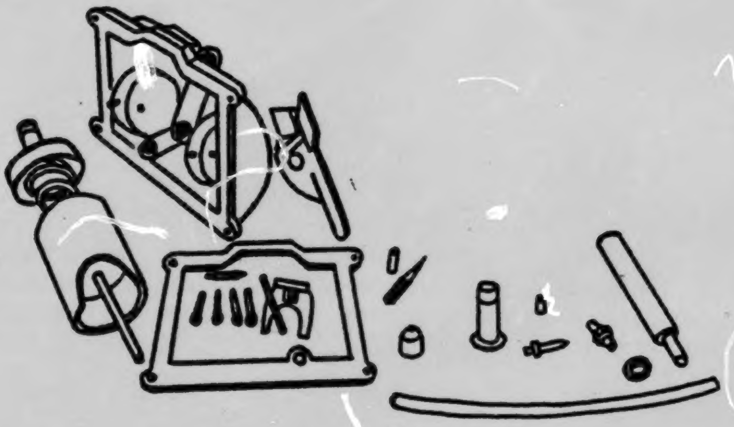


JOB STEPS

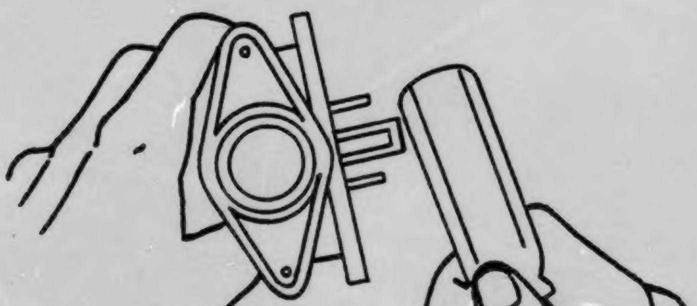
13. Next, remove jet needle holder.



14. Keep track of all small parts.

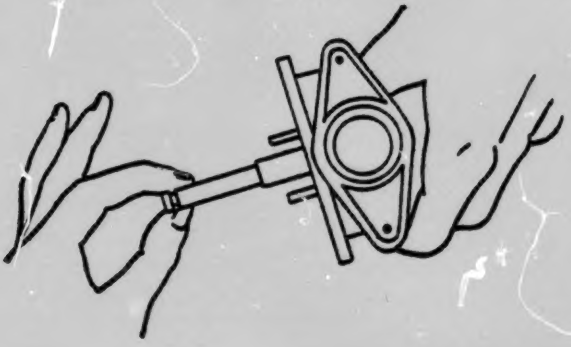


15. To remove the needle jet, screw holder back in without the washer. Tap it with a screwdriver to break it loose.

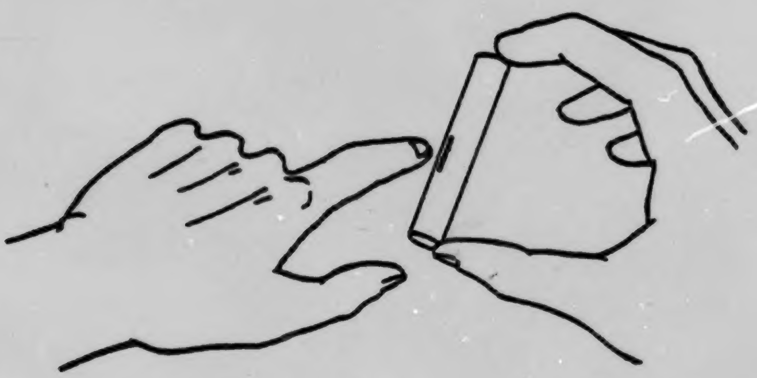


JOB STEPS

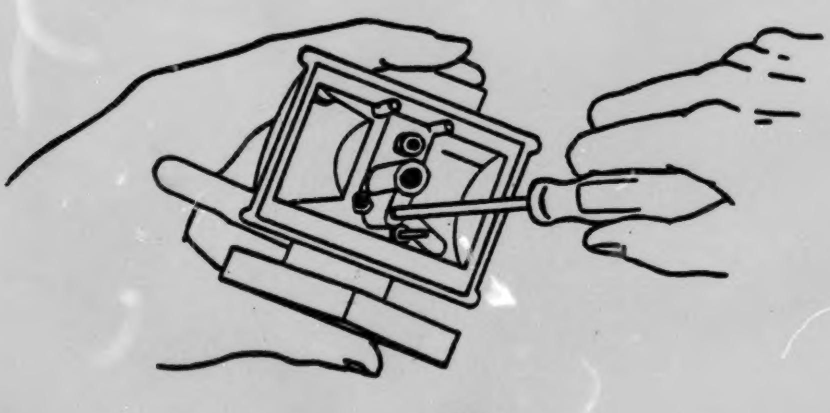
16. Turn over the carburetor and gently tap the needle jet out.



17. If you want to know the size of the needle jet, it is stamped on the side.

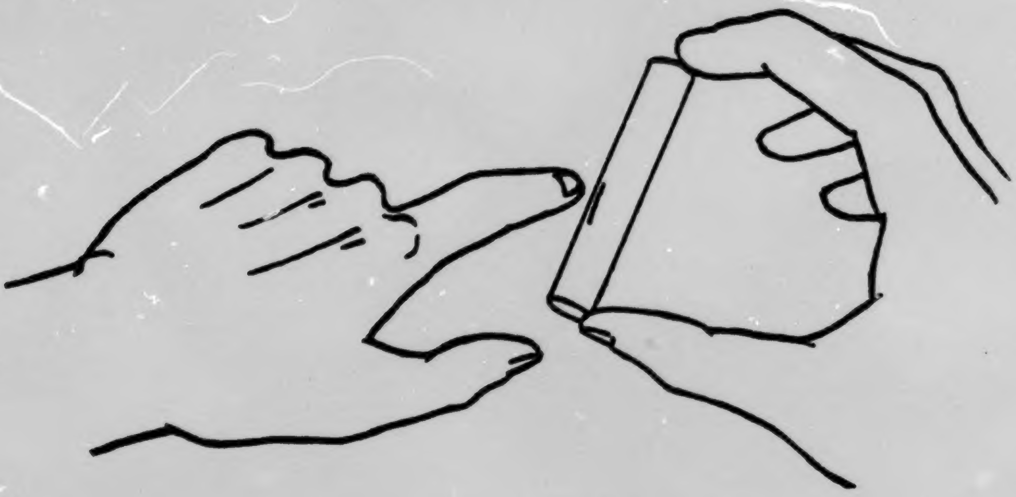


18. Using a small screwdriver, unscrew the pilot jet.

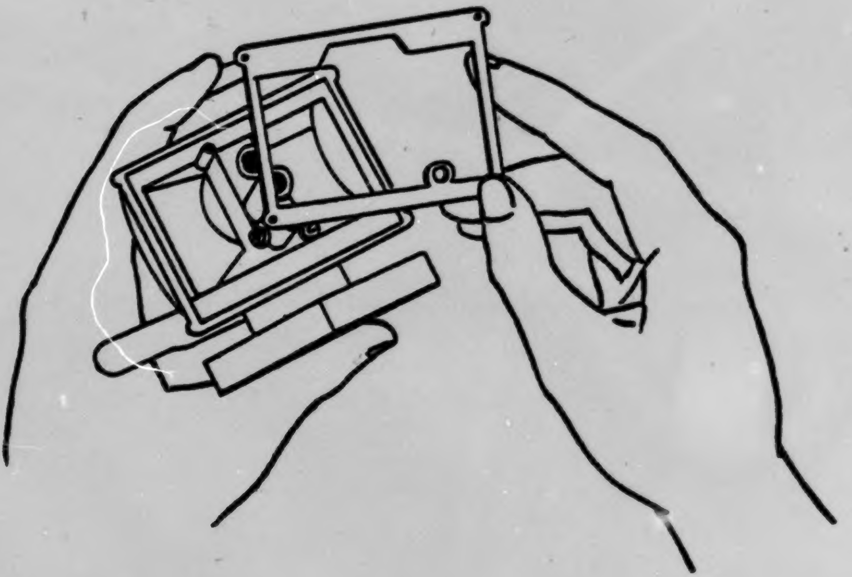


JOB STEPS

19. Again, jet size is stamped on the side of the barrel.

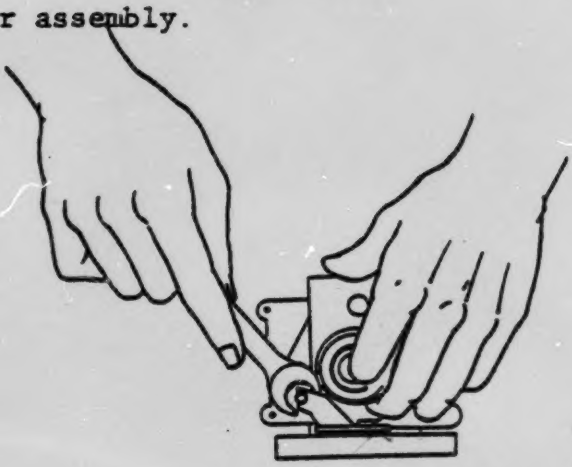


20. If the carburetor is to be dipped in a cleaner, remove the float bowl gasket. It is a good idea to replace this gasket if you can.

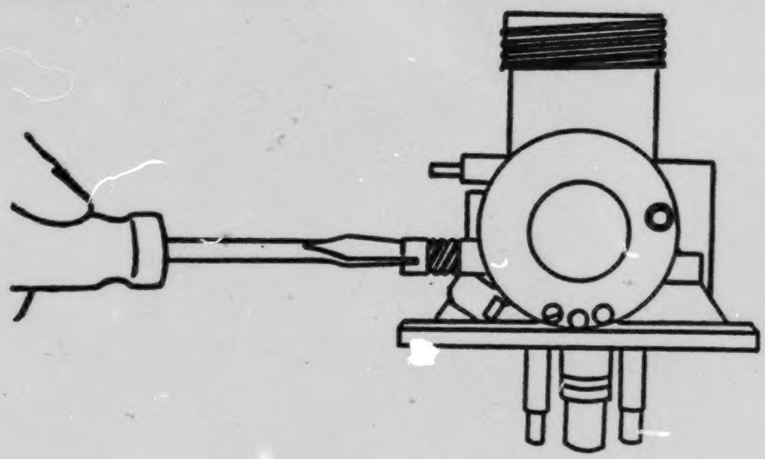


JOB STEPS

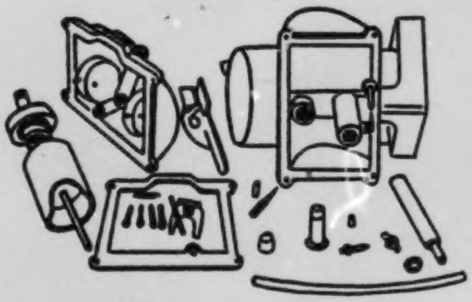
21. Remove starter assembly.



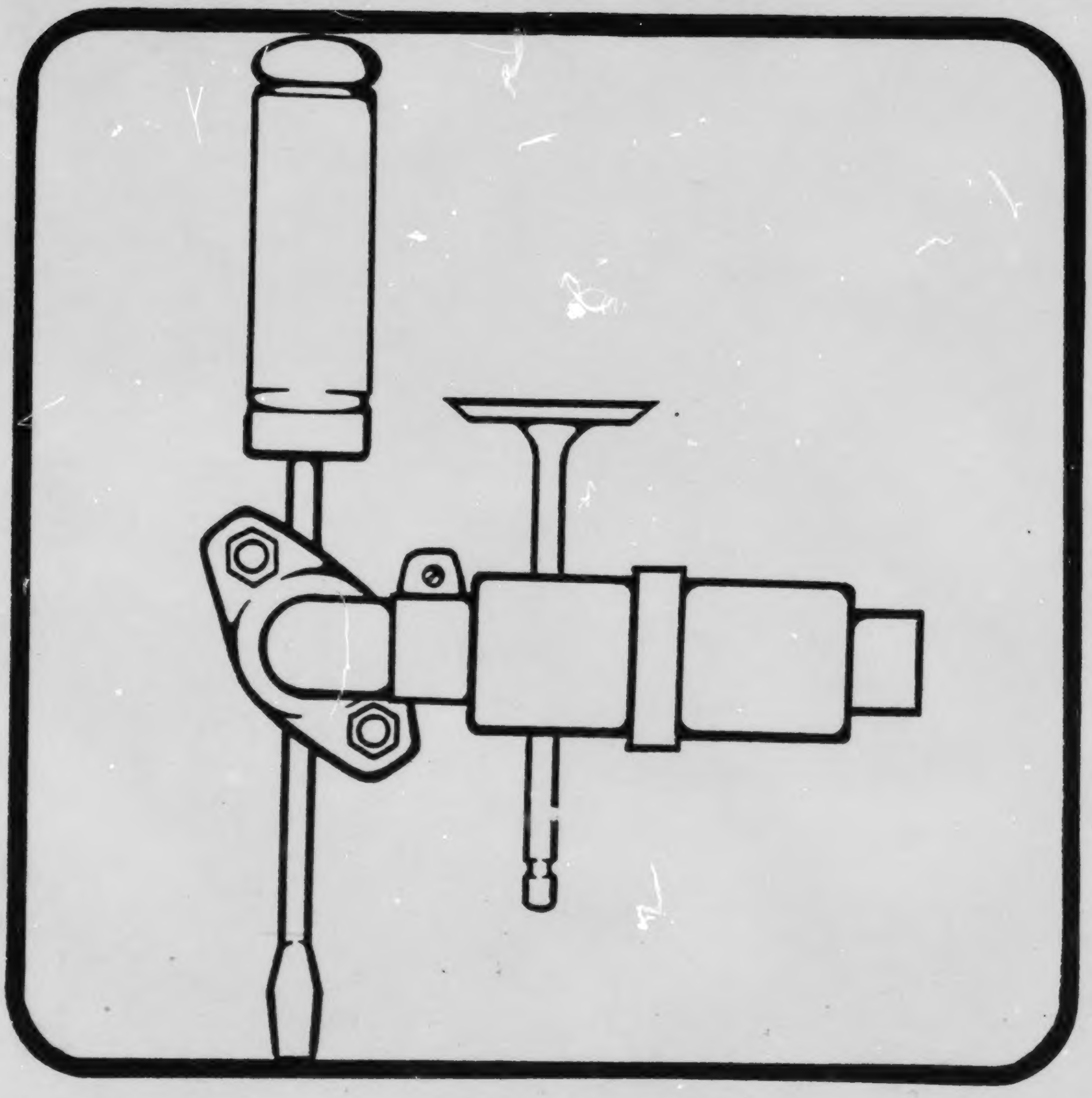
22. Remove the idle air screw.



23. When disassembly is complete, it should look like the picture below.



24. Reassembly of the carburetor is in reverse order of disassembly.



small engine repair

unit: CARBURETOR

capital area career center

module: 7501 05 004 date: July 1977 level: I

skill title: Carburetor Overhaul - Suction Type

developed & written by: Jack Helder

visuals by: Bruce Bennett & Dave Wehrwein

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to overhaul a suction type carburetor used on a four-cycle Briggs and Stratton engine.

IN ORDER TO DO THIS YOU WILL NEED:

Engine with suction type carburetor

Hand tools

Service manual for the kind of carburetor on which you are working.

Safety Glasses

WE WILL KNOW YOU CAN DO IT WHEN:

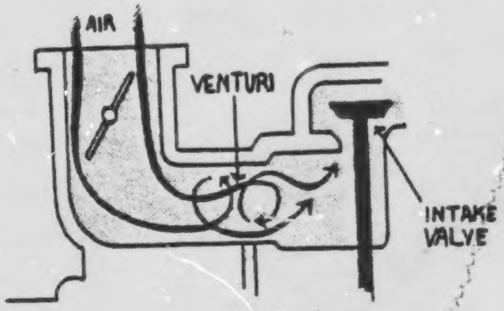
You have overhauled the carburetor according to service specifications and it works well on the engine.

WORD GUIDE

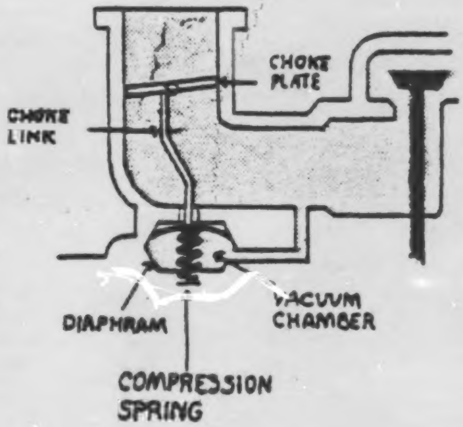
VENTURI - Part of carburetor throat that narrows down to a smaller diameter. Causes a vacuum that sucks fuel from needle valve into the stream of air.

INFORMATION

The suction carburetor is the simplest kind. There is only one fuel mixture adjustment. Air is drawn into the air horn to the throat. Vacuum from the engine draws air through the venturi where it is mixed with fuel before going into the engine's intake valve.

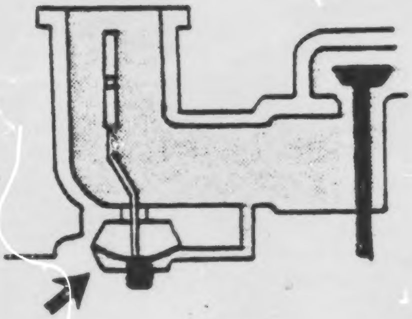

AIR
VENTURI
INTAKE VALVE

A diaphragm under the carburetor is connected to the choke shaft by a link. A spring holds the diaphragm and the choke valve closed when the engine is cold.

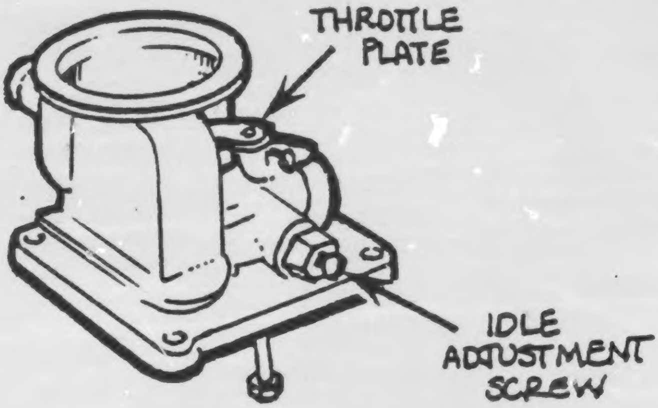

CHOKE PLATE
CHOKE LINK
VACUUM CHAMBER
DIAPHRAM
COMPRESSION SPRING

INFORMATION

When the engine is started, a vacuum is created during the intake stroke that pulls down the diaphragm. This opens the choke.



The speed of the engine is controlled by the position of the throttle plate. This regulates the amount of air-fuel mixture going into the engine.



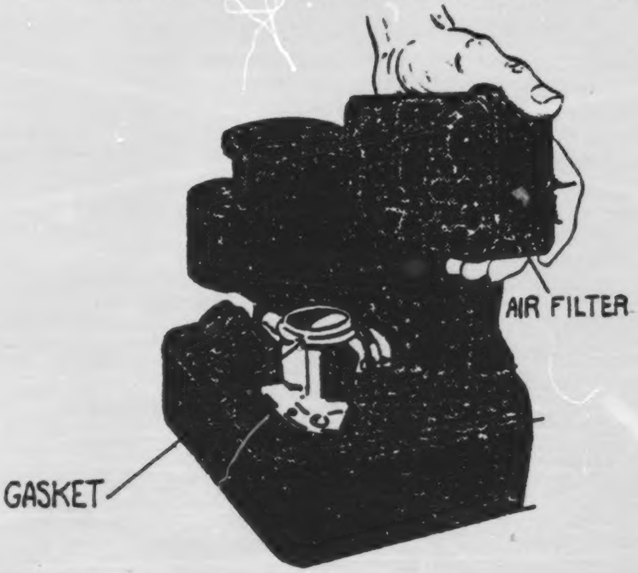
The carburetor we are going to overhaul is for a Briggs and Stratton engine.

JOB STEPS

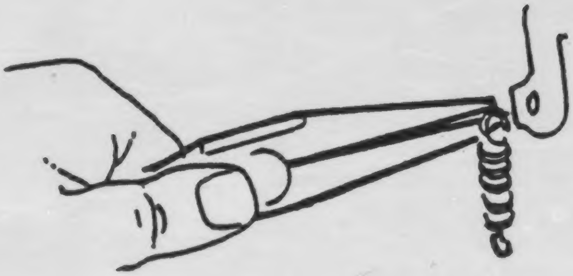
1. Take all equipment to your work area.

2. Check service manual for any special information on your carburetor (such as special tools needed, parts that need special care or how much fuel is needed in the tank when setting the carburetor - usually 1/2 tank on suction type carburetors).

3. Remove the air filter from the carburetor. Check the gasket.

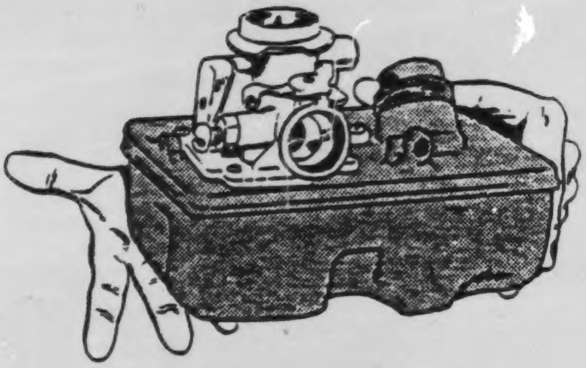


4. Remove the throttle control link and governor control link from the throttle plate.

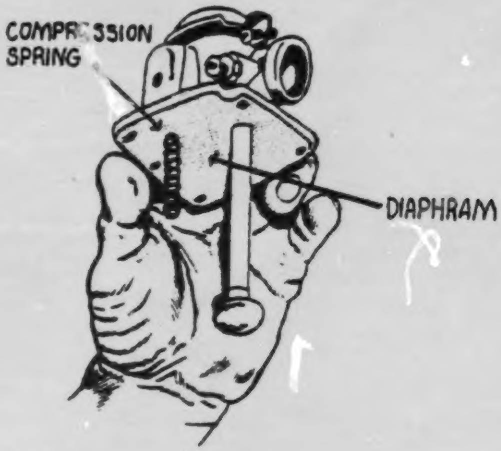


JOB STEPS

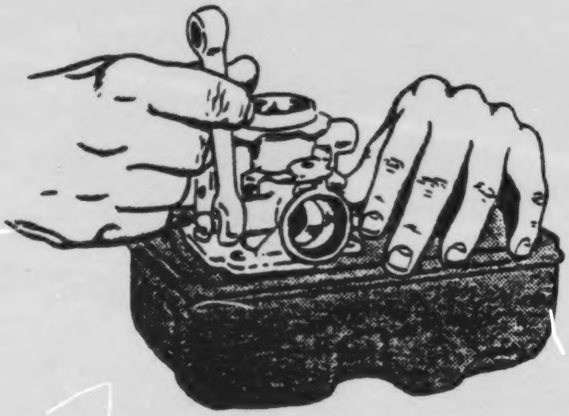
5. Remove the carburetor and fuel tank from engine.



6. Remove carburetor from fuel tank. Be careful not to tear the diaphragm or lose the compression spring.

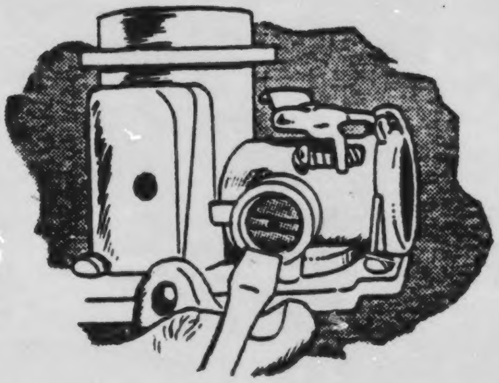

COMPRESSION SPRING
DIAPHRAM

7. Remove the needle valve assembly.

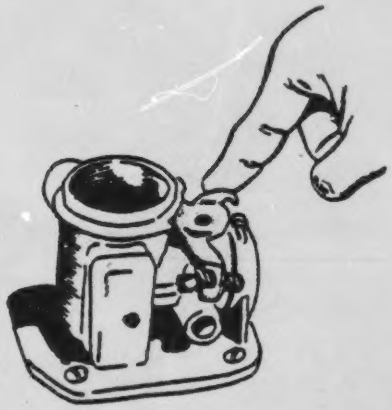


JOB STEPS

8. Unscrew the fuel nozzle.



9. Check throttle plate and bushings. Replace any worn or broken parts.



10. Put all Metal parts into carburetor cleaner. Let parts soak for 20 minutes.

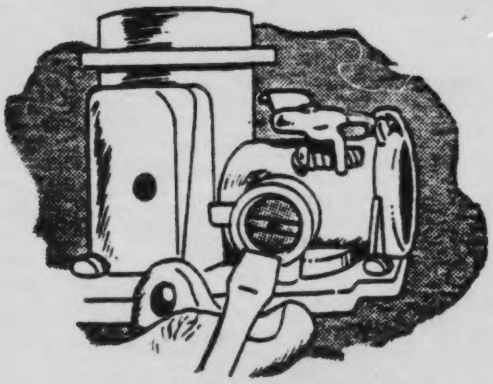
CAUTION: Cleaner can burn eyes and skin! Be careful!

11. Remove parts from cleaner and rinse in oleum.

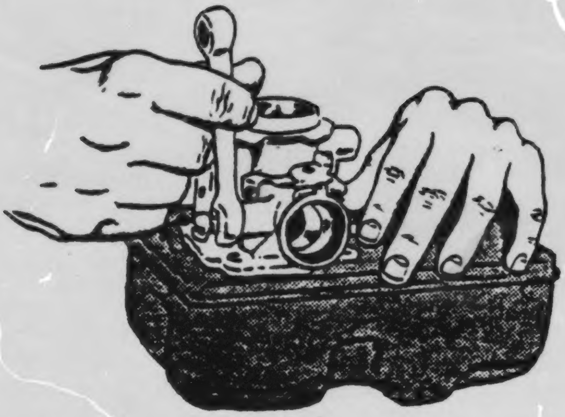
12. After parts are rinsed, blow them out with compressed air.

JOB STEPS

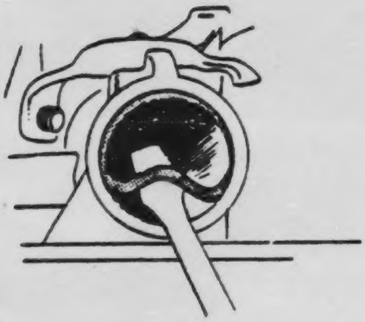
3. Replace nozzle.



14. Put together needle valve assembly and replace. Tighten with a wrench.



15. Check O-ring and replace if necessary.



JOB STEPS

16. Check diaphragm and compression ring. Be sure there are no tears in the diaphragm and that the spring is in place. Check service manual for any special instructions.

17. Install carburetor on fuel tank.

18. Put carburetor and fuel tank back on the engine.

19. Replace throttle and governor linkages.

20. Fill gas tank to the level needed to best set carburetor.

21. Replace air filter.

22. Have your instructor help you start and set the carburetor according to specifications in the service manual for your engine.

small engine repair

unit: Carburetor

capital area career center

module: 7501 05 005 **date:** 7/77 **level:**

skill title: Remove And Replace Carburetor

developed & written by: Jim Pitts

visuals by: Dave Wehrwein

WORD GUIDE

LINKAGE - Parts which connect other parts together.

PERFORMANCE OBJECTIVE

You are going to learn:

How to remove and replace a carburetor on an air-cooled engine.

And in order to do this you will need:

An air-cooled engine with a vane governor

Hand tools

A manual for the kind of engine on which you are working.

We will know you can do it when:

The carburetor is mounted so that there are no fuel leaks, the linkage works properly and the engine runs well after throttle and governor adjustment.

INFORMATION

In this module, you are going to learn how to remove and replace a carburetor on an air-cooled engine. There are many different kinds of engines so you will need a service manual for the kind of engine on which you are working. Read Air Cooled Engine Mechanics Training Manual, pp 33-35.

When you replace a carburetor you should also put in a new gasket. This will help seal the carburetor to the block.

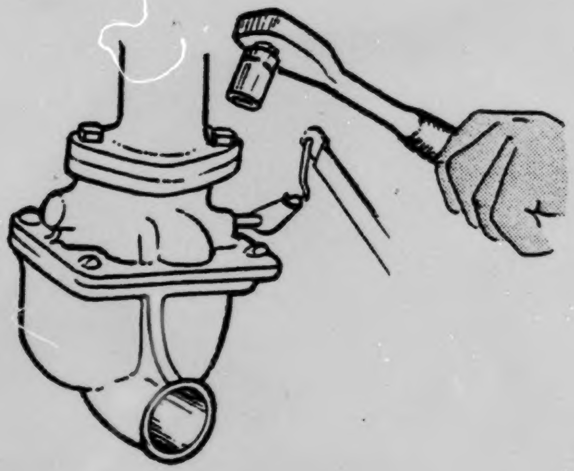
When you get ready to adjust the carburetor with the engine running, refer to module 7501 05 007.

WORD GUIDE

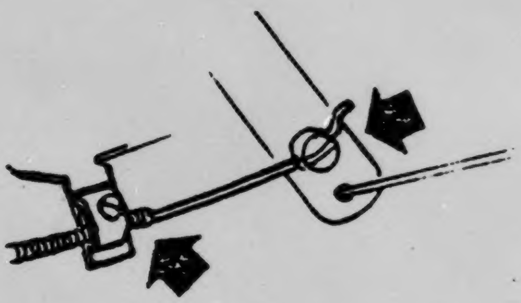
GOVERNOR - Device which controls speed.

JOB STEPS

1. Get your equipment and go to your work area.
2. Get the service manual for the kind of carburetor on which you are working. Look up the specifications you need.
3. Look at the way the governor arm is hooked to the carburetor. Make a drawing if needed, but be sure of how to hook it back up.
4. Using a socket-set wrench, remove the bolts that hold the carburetor to the block.

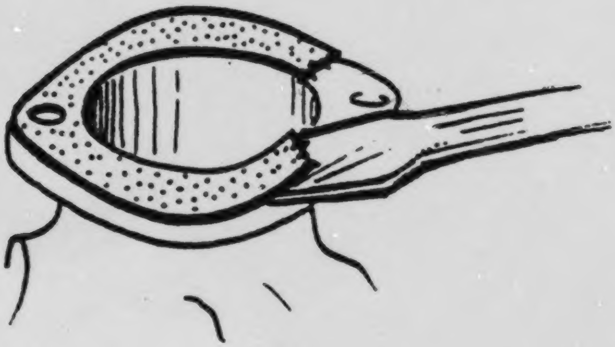


5. Unhook the governor control link and spring.
6. Using needle-nose pliers, remove the throttle and choke linkage.



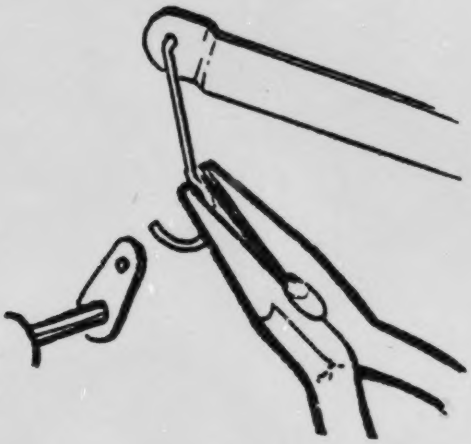
JOB STEPS

7. Using gasket scraper, clean the old gasket.



8. Put the throttle and choke linkage onto the new carburetor.

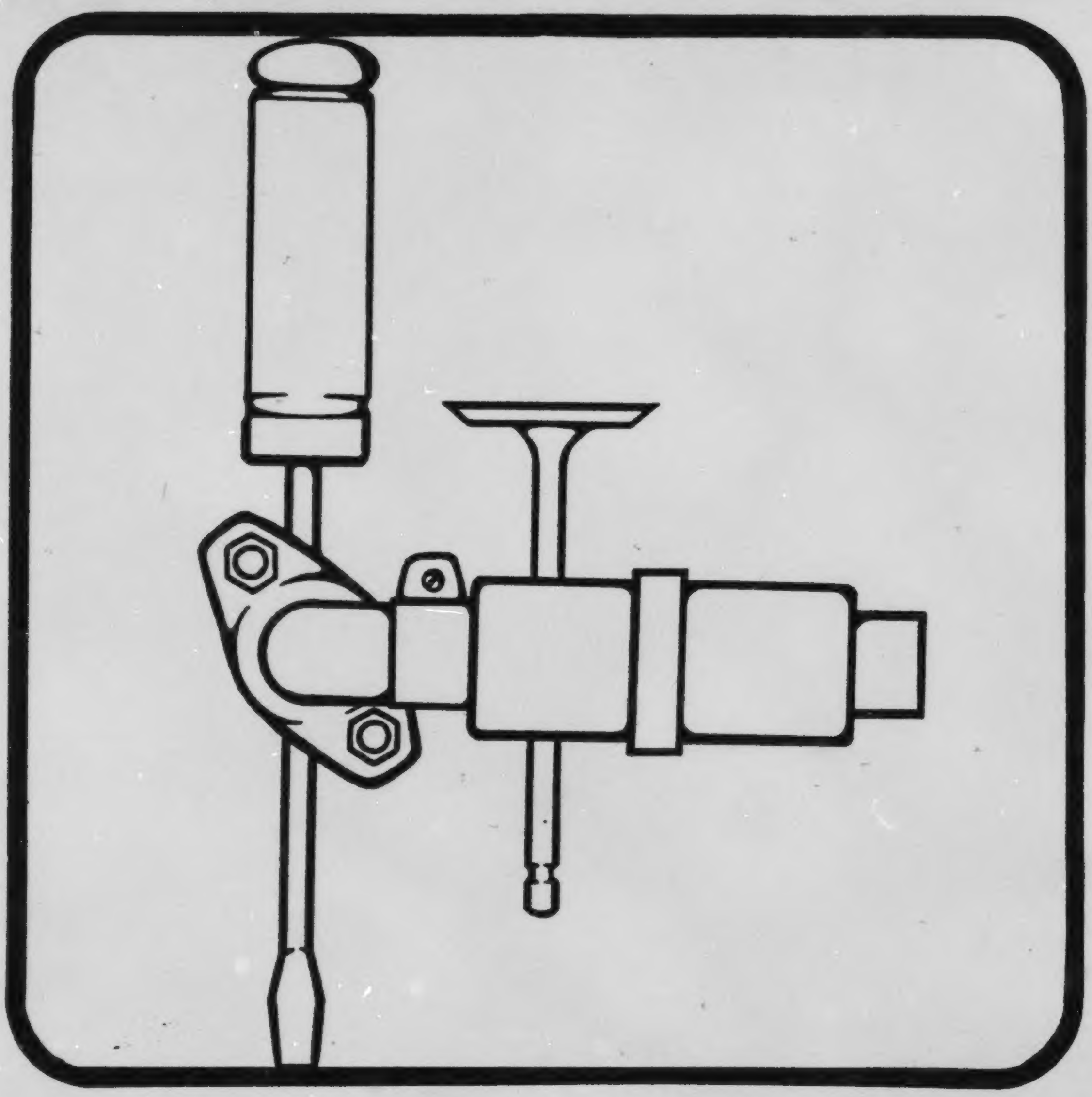
9. Put the governor linkage onto the carburetor.



10. Bolt the new carburetor onto the block. Be sure to put in the new gasket.

11. Start the engine and let it warm up.

12. Adjust the new carburetor for proper engine operation. Use the information you learned in module 7501 05 007.



small engine repair

unit: CARBURETORS

capital area career center

module: 7501 05 006 date: May 1977 level: I

skill title: Service and Adjust Governors

developed & written by: Jim Pitts

visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How a governor works and how to adjust an air vane governor on a Briggs & Stratton engine.

AND IN ORDER TO DO THIS YOU WILL NEED:

Briggs and Stratton engine with an air vane governor

Service manual

Hand tools

Safety glasses

WE WILL KNOW YOU CAN DO IT WHEN:

The engine operates properly, with or without load, at the specific r.p.m.

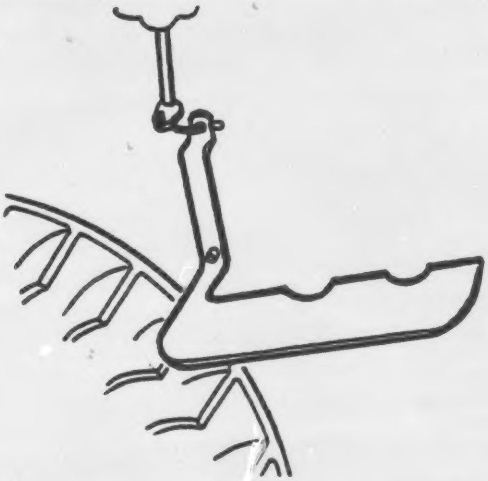
INFORMATION

Engine governors do three things:

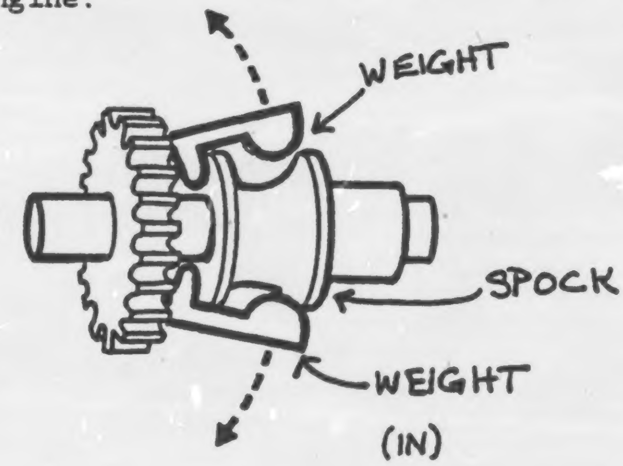
1. They maintain chosen engine speed.
2. They keep the engine from running too fast.
3. They keep the engine from running too slow.

These are two main types of governors:

The air vane governors operates by a stream of air caused by the flywheel cooling fins.

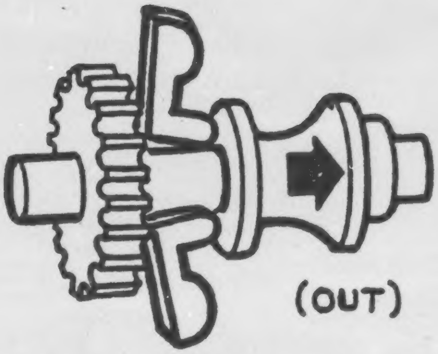


A centrifugal, or mechanical, governor uses weights attached to a shaft driven by the engine.



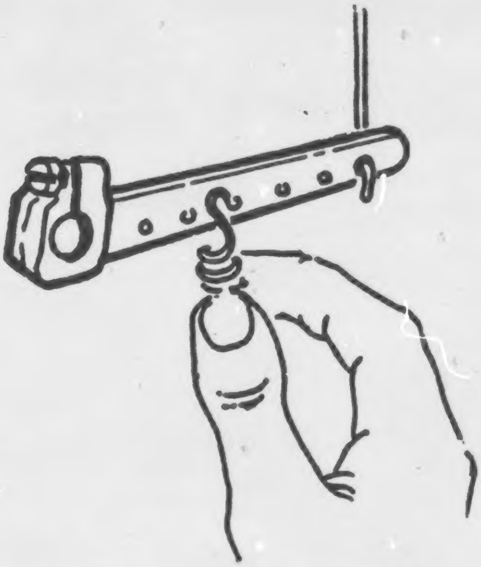
The above picture shows the weights "in" while the engine runs slowly.

INFORMATION



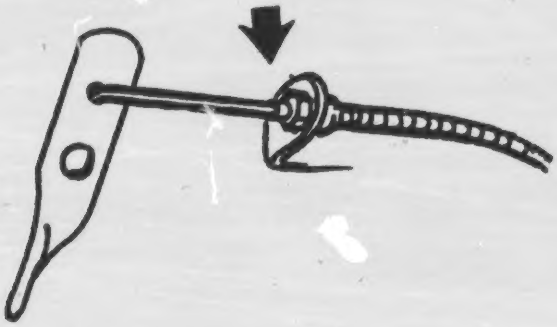
This picture shows the weights "out", while the engine runs fast. The weights force the spool up, changing the position of the throttle valve.

The speed range of the governor can be changed by adjusting the remote control cable.



INFORMATION

Another way you can change the governor speed range is by turning an adjusting nut.



WORD GUIDE

"**FREE UP**" - Loosen by moving or lubricating.

JOB STEPS

1. Get an engine with an air vane governor from your instructor and go to your work area.

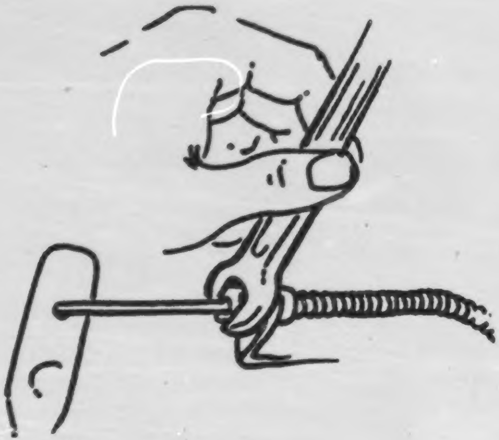
2. Get the service manual for the kind of engine on which you are working.

WEAR YOU SAFETY GLASSES!

3. Start the engine to check its operation. Then, shut it off.

4. Check the governor linkage. Be sure it works easily and smoothly. Free up any parts that do not work.

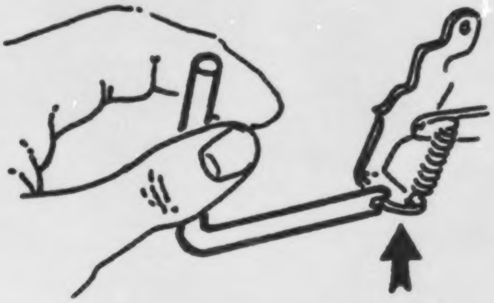
5. Find the speed adjusting nut on the governor. Turn it to be sure it works.



6. Check to see what model engine you have. The chart on the next page will give you the operating speed range for this engine.

JOB STEPS

7. Check the vane to be sure it does not rub on the magneto. The vane can be adjusted by bending the bracket.



8. Start the engine. Turn the adjusting nut up and down. Notice how the engine speed changes.

9. Set the governor to the proper engine operating range. Then, shut off the engine.

Briggs & Stratton recommended operating speed ranges.

MODELS	*ENGINE RPM
5S, 6S, 6HFB & 6 HS	2200 - 3200
Other 5 & 6 models	2600 - 3600
8 & N	2600 - 3600
9	1800 - 3600
14	1800 - 3600

*Engine RPM may differ slightly for different equipment on which B & S engines are used. Use the equipment manufacturer's specs in all cases.

JOB STEPS

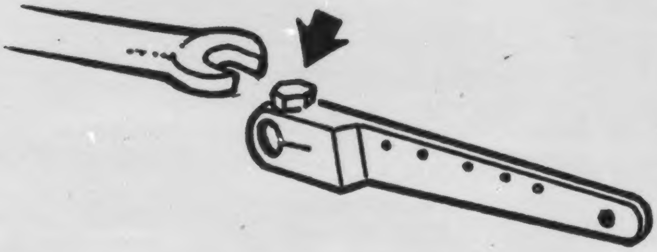
10. To adjust a governor with mechanical linkage;

    A. Loosen the bolt that adjusts the governor lever to the governor shaft,

    B. Set the carburetor throttle to the wide open position,

    C. Turn the governor weights so they are in,

    D. Tighten the governor clamp bolt.

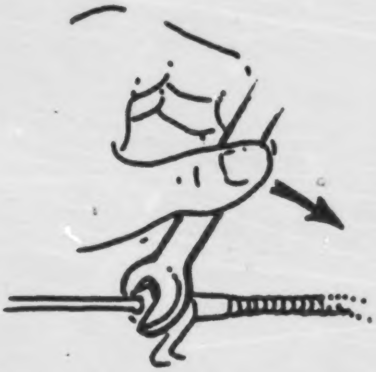


11. To adjust the governor with remove control cable;

    A. Start the engine,

    B. Loosen the adjusting control locknuts,

    C. Set the governor to the desired setting and tighten the locknuts.



12. Ask your instructor to check your work.

small engine repair

unit: Carburetors

capital area career center

module: 7501 05 007 date: 5-4-77 level: 1

skill title: Engine Running - High and Low Speed Adjustments

developed & written by: Jim Pitts

visuals by:

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to adjust a carburetor on a runable Briggs and Stratton 4-cycle engine.

AND IN ORDER TO DO THIS YOU WILL NEED:

Briggs and Stratton Engine

Hand Tools

B & S Service Manual

WE WILL KNOW YOU CAN DO THIS WHEN:

You complete the job steps so that the engine runs smoothly within the R.P.M. limit specified by the manufacturer.

INFORMATION

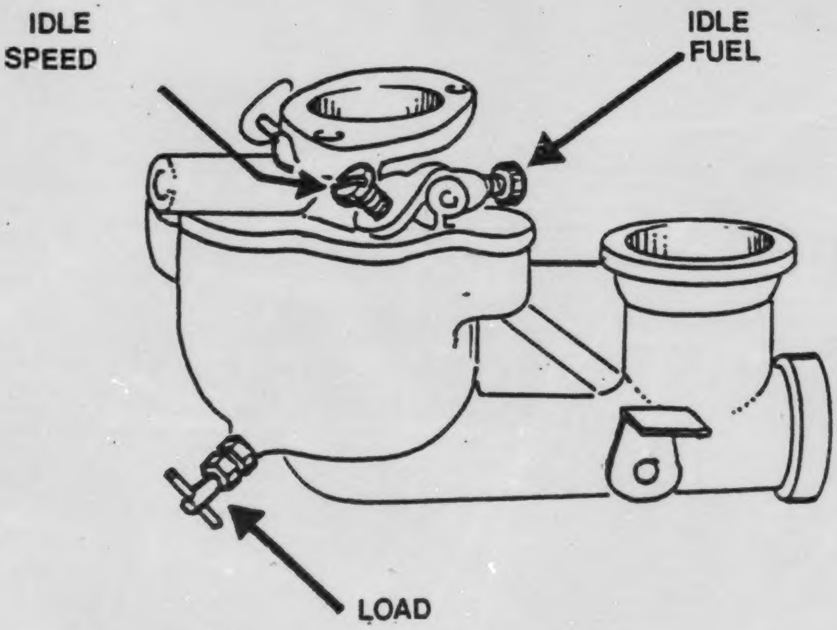
All carburetors should be adjusted for smooth, economical performance.

Most carburetors have three adjustments:

1) idle speed
2) idle fuel
3) full load fuel

The basic adjustment procedure is the same for all carburetors. Different kinds of carburetors might have small changes in the basic procedure.

The picture below illustrates carburetor parts you will need to know in order to make an adjustment.



Some carburetors do not have idle air adjusting screws, they only have high speed and idle speed screws. These carburetors make engines idle more roughly. See following pages for carburetors without idle air adjusting screws.

JOB STEPS

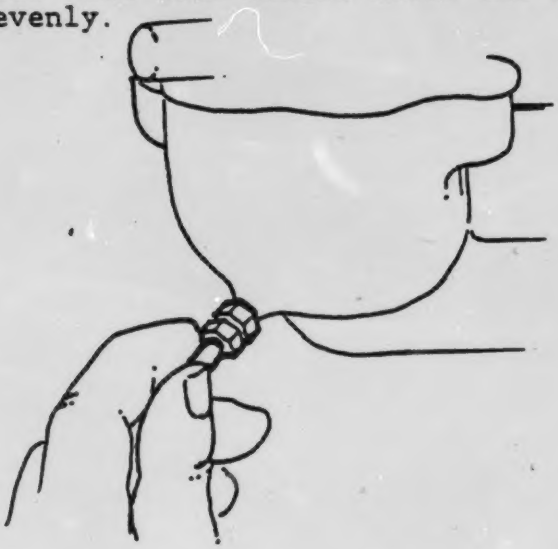
1. Get equipment from instructor. Be sure engine runs.

2. Check manual for your engine's adjustment specifications.

3. Start the engine and let it warm up. Be sure nothing is is the way of the mower blades.

4. Run the engine under full load, at operating speed.

5. Turn in screw for full load needle until the engine starts to miss or run unevenly.



6. Turn out screw until the engine runs smoothly or evenly.

7. Slow the engine to idle speed.

8. Adjust the screw for idle speed until the engine is running at specified R.P.M. (usually 1750 r.p.m.)

9. Adjust the screw for idle fuel mixture until engine idles smoothly. Turn the screw in until the engine runs roughly.

WORD GUIDE

GOVERNOR - device which limits the speed an engine runs.

JOB STEPS

10. Turn out screw for idle speed until the engine runs smoothly.

11. Check the idle speed again. If necessary, reset idle speed.

12. Check the operation of the speed control. The engine should go from idle to full speed without sputtering or hesitating.

13. If the governor does not work properly, reset it using the procedure you learned in module 7501 05 006.

14. Put away all equipment.

small engine repair

unit: ELECTRICAL

capital area career center

module: 7501´06 001 date: 2/77 level: II

skill title: Checking an electric start system

developed & written by: Dennis Parker

visuals by: Dave Wehrwein

WORD GUIDE

BRIDGING CIRCUITS - A method used to bypass parts of the electrical circuit for example, the solenoid, or starter switch.

VOLT-OHMMETER - A meter used to measure voltage or resistance of electric components.

SOLENOID - A magnetic switch.

PERFORMANCE OBJECTIVE

You are going to learn:

How to check the electrical starting system, including: the proper wiring, the operation of the starter switch and solenoid, and how to check the completeness of the system's circuits by bridging the components in that system.

And in order to do this you will need:

Twelve volt starting system

One volt-ohmmeter

One screwdriver set

One socket set

One open-end wrench set

We will know you can do it when:

The electrical system you have checked is a completed circuit and starts the engine.

INFORMATION

Before you start, be sure you know the answer to these questions:

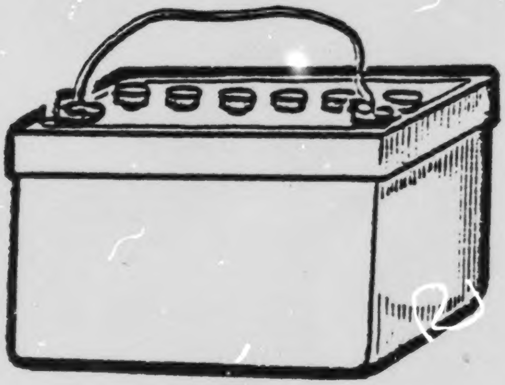
1. What make of engine are you working with?
2. What type of starting system does your engine use?
   - A. Starter-generator with manual start switch.
   - B. Starter-generator with manual start switch.

For instance, see the Briggs & Stratton section on starter, page 9.

NOW DO

Read the section in the repair manual that tells about your engine starter system. This will help you to learn the location of the different parts in that particular system.

CAUTION! The battery you are using contains acid. Do not get this acid on your hands or clothes or in your eyes. Also, do not connect a jumper wire on the battery. The battery may explode.



NO!

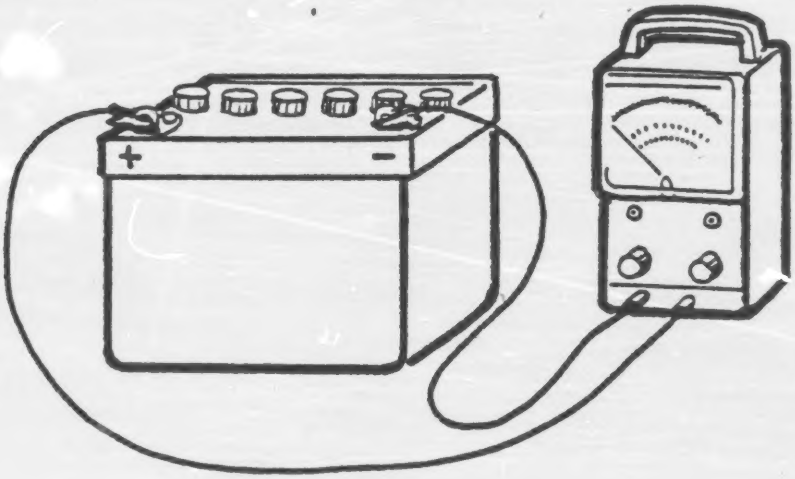
DON'T DO IT THIS WAY!

JOB STEPS

1. Be sure that you have learned the layout of the starter system.

CAUTION! Before starting to work, disconnect the spark plug wire.

2. Is your battery good? Check it with the volt-ohmmeter. Set the meter for volts and check across the battery terminals. If you don't remember how, check mods 7401 07 001, 7401 07 002, 7401 07 003, 7401 07 005.

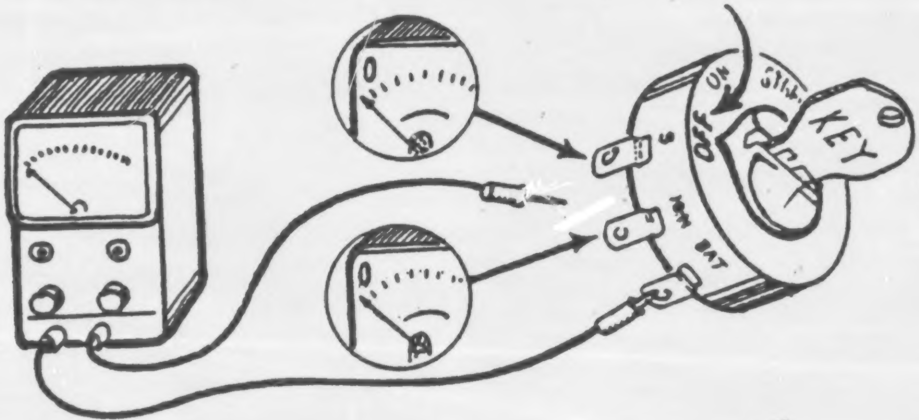


If you do not remember how to use the volt-ohmmeter ask the instructor for help.

JOB STEPS

These steps are for a battery ignition type system.

3. With the battery disconnected check the circuit of the starter switch with volt-ohmmeter. (set to resistance) With the switch "off," there should be no connection between any of the terminals on the switch. Set the switch to "on." You should find a connection between the battery terminal and the ignition terminal. Hold the switch to the "start" position. All the terminals should show connections between each other.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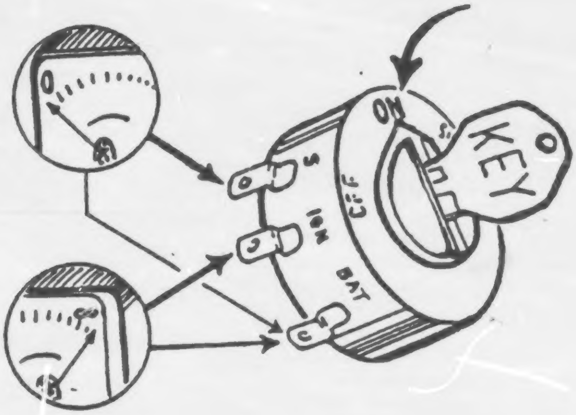
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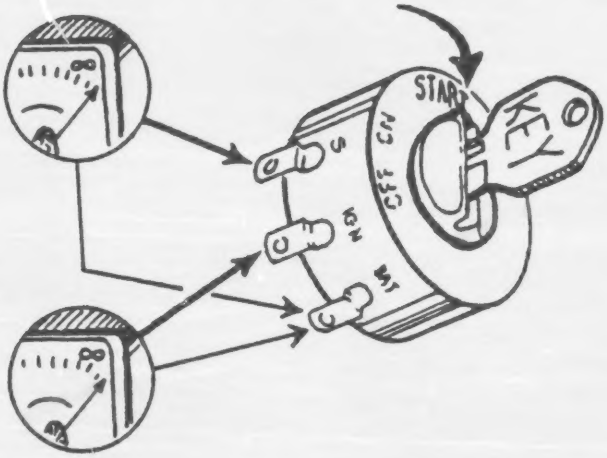
∞
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START
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KEY
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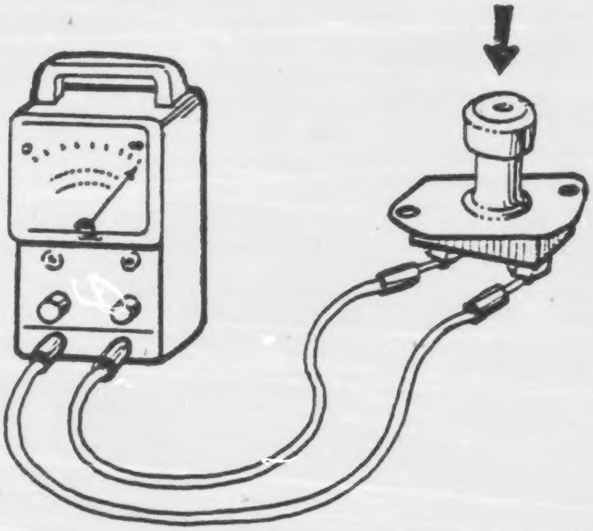
JOB STEPS

4. If you do not get the same results ask the instructor for a new switch.

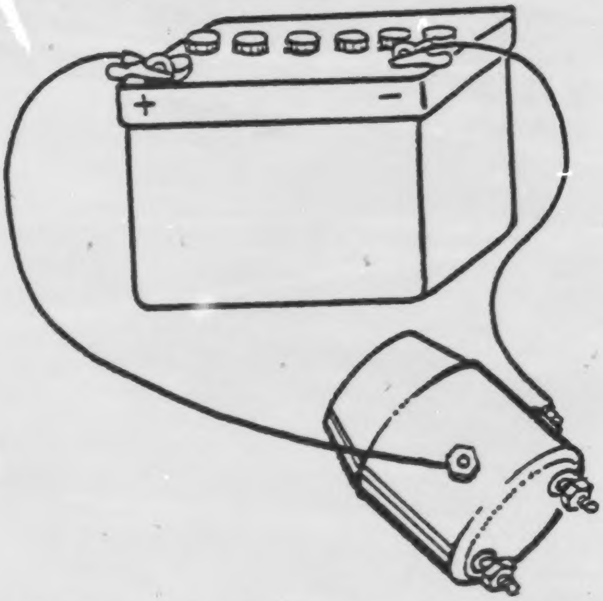
5. To check the manual starter switch, push the switch button and check for connection on the big terminals of the switch.



If you don't get the same reading ask the instructor for a new switch.

JOB STEPS

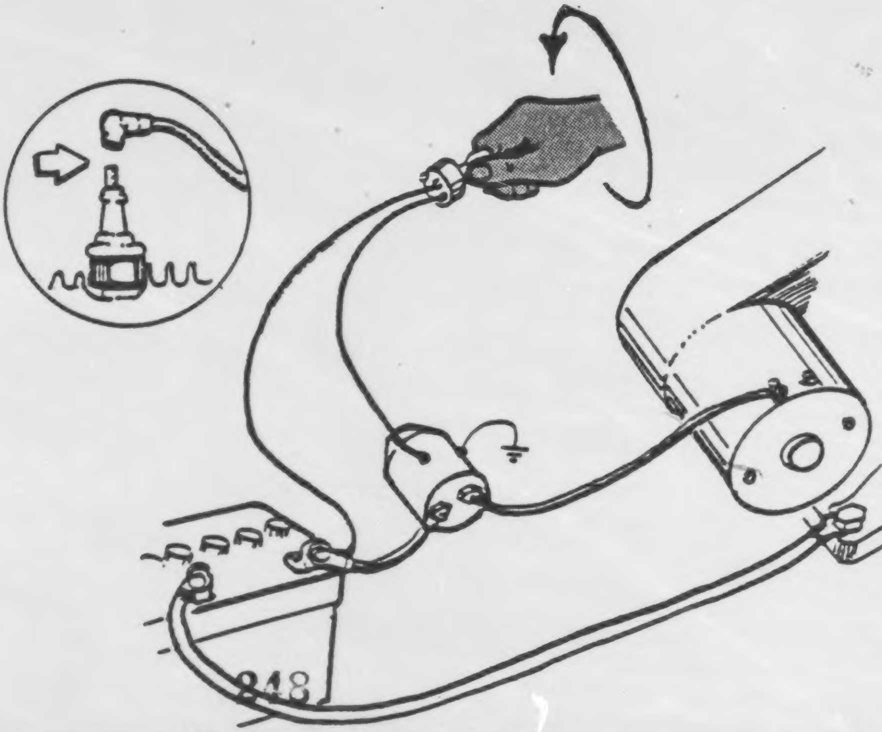
6. Electric solenoid may be checked by hooking the solenoid to a battery and checking its operation with a meter.



NOTE:

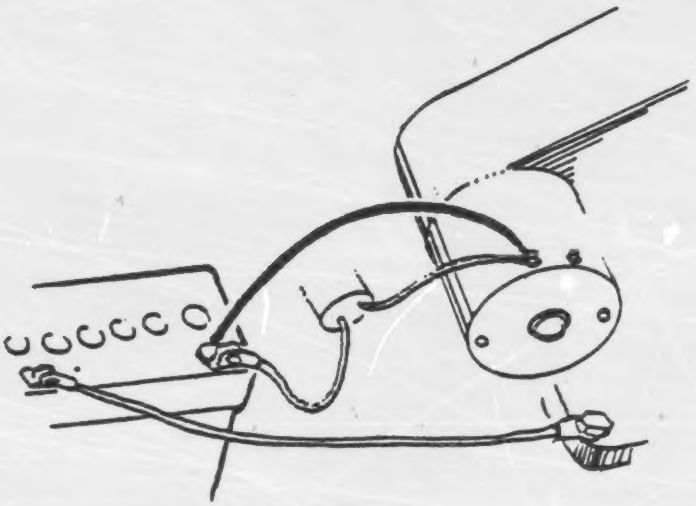
Have the instructor check your hook-up. When the battery is connected to the circuit, the solenoid should "snap." If it doesn't, get a new one. When the solenoid snaps the meter needle should go to "0". If not, replace the solenoid.

7. Reconnect the complete circuit of the system except the spark plug, try the starter. Does it turn the engine? If so, go to Job Step 8.



JOB STEPS

8. If your engine didn't turn over the starter motor may be bad. Bridge the complete circuit from the battery to the starter with a jumper wire (see Job Step 2).

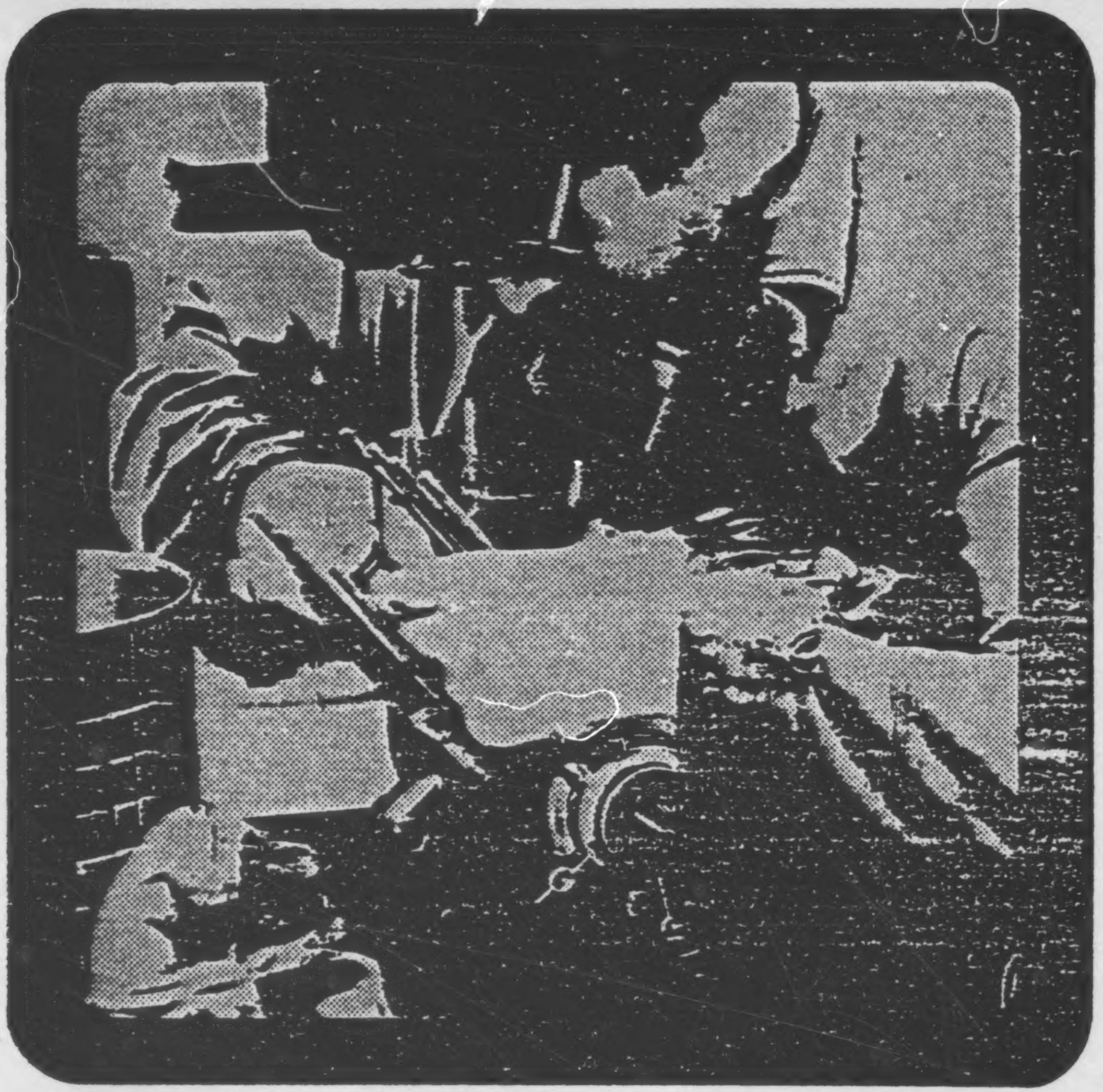


If the starter turns the engine, check your wiring for breaks, sparks, or poor connections if not, the starter may be bad. Ask the instructor for help.

9. Reconnect the spark plug wire.

10. Start the engine. If the engine does not start, ask your instructor for help.

11. Be sure to clean up your work area when you are done.



small engine repair

unit: Electrical

capital area career center

module: 7501 .06 002 date: 4-14-77 level: 2

skill title: Check AC Charging System

developed & written by: Dennis Parker

visuals by: Dave Wehrwein

WORD GUIDE

RECTIFIER - a device used to change alternating current (A/C) into direct current (D/C).

STATOR - the stationary part of the A/C generator or alternator.

LOAD-LAMP - lamp used to check the output from the charging system.

PERFORMANCE OBJECTIVES

You are going to learn:

1. How to check an A/C charging system including the rectifiers, with a volt-ohmmeter.
2. How to check the stator and stator coils for signs of heat, distortion and cracking.

And in order to do this you will need:

an engine with an A/C charging system

1 socket set

1 screwdriver set

1 openend wrench

1 load lamp with leads

1 impact nut or puller

1 hammer

1 volt-ohmmeter

1 torque wrench

We will know you can do it when:

The charging system on which you worked operates according to the service manual specifications.

INFORMATION

1. With what make engine are you working?

2. What type A/C charging system does it have?

   a. 1 1/2 amp
   b. 4 amp
   c. 7 amp
   d. dual circuit

Check the B & S Repair Manual and the engine nameplate.

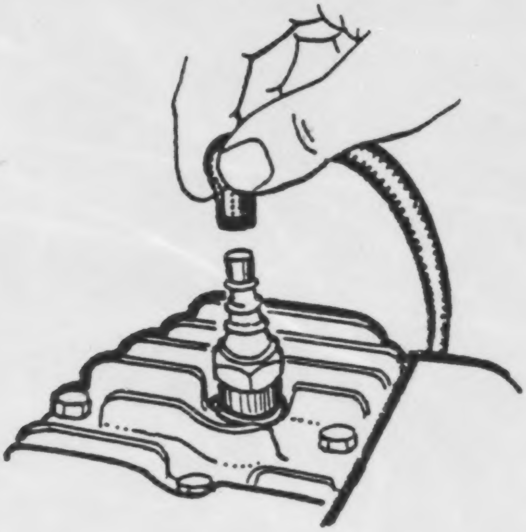
NOW DO:

Read section 7 in the B & S Repair Manual to check the engine nameplate and charging system on which you are working.

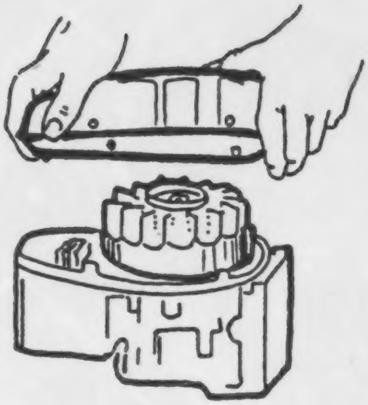
CAUTION: When you check the charging system, be sure the engine is running. BE CAREFUL AROUND THE ENGINE'S SPINNING PARTS.

JOB STEPS

1. Remove the spark plug wire so engine will not start.

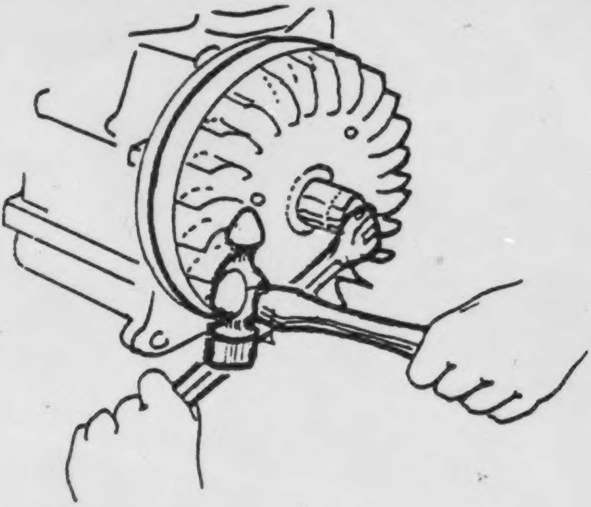


2. Using screwdriver and wrench, remove flywheel cover or shroud.

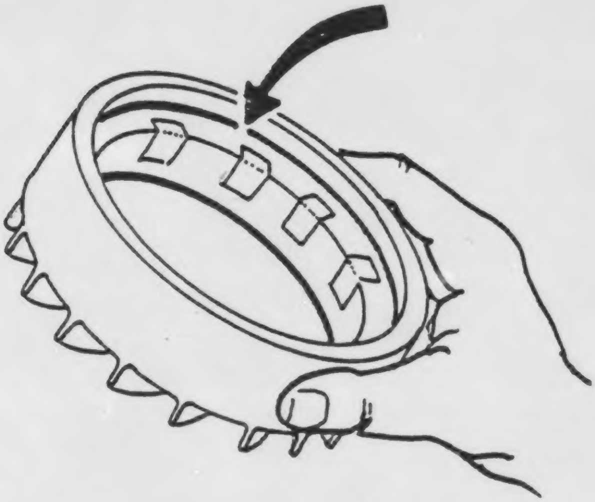


JOB STEPS

3. Using wrench, impact nut puller and hammer, remove flywheel nut and flywheel. Don't lose the key.

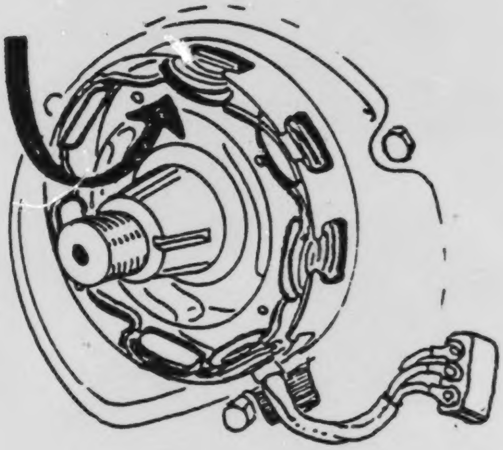


4. Check the flywheel magnet ring on the inside of the flywheel. Is it loose or broken? Does it rub on the stator?

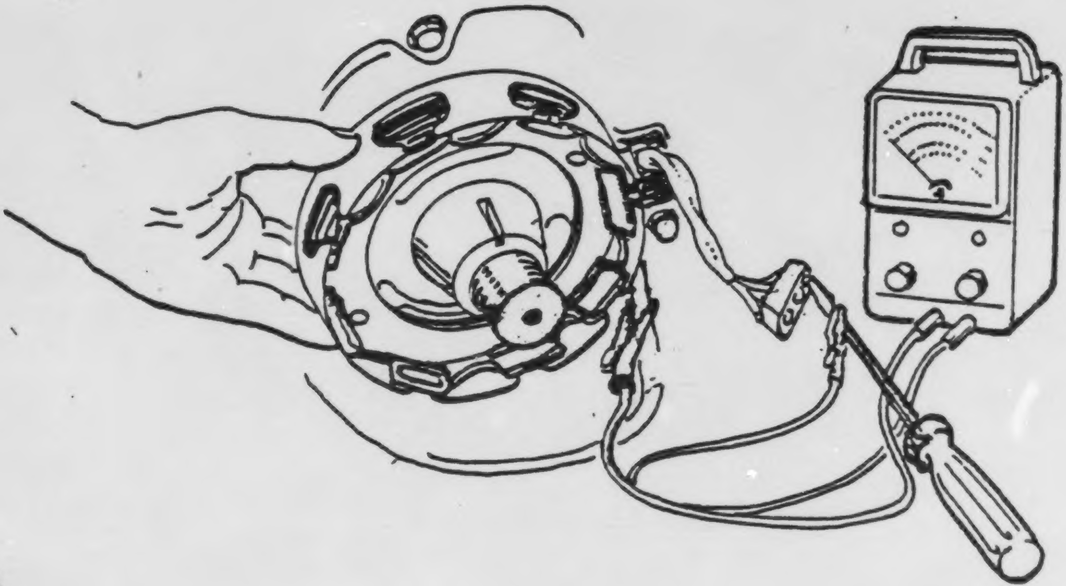


JOB STEPS

5. Check the coils on the stator for rubbing, cracking, or burnt spots.



6. Using the screwdriver and volt-ohmmeter, (set for ohms) and with the stator wires unplugged (on 1 1/2 amp model the rectifier box must not be touching the engine), check for continuity between the stator wires and the engine block. There should be no connection.



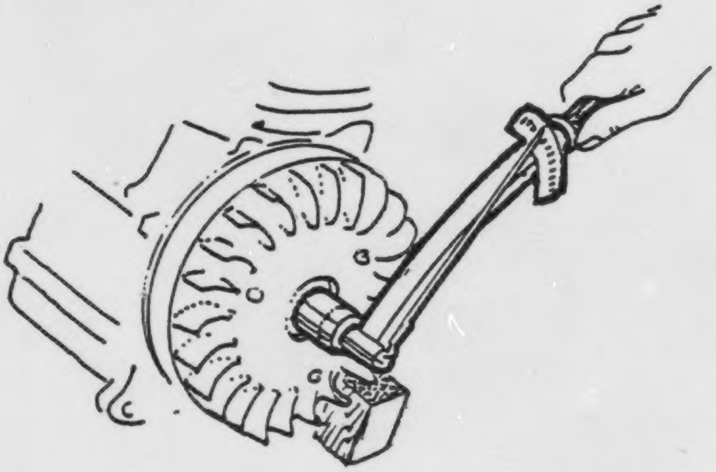
JOB STEPS

7. Using the volt-ohmmeter, screwdriver and wrench, check the rectifier, (on 1 1/2 amp model, bolt the rectifier box back on the engine). See the B & S Repair Manual for the correct hook-up for your charging system.

   NOTE: If you do not understand the proper rectifier checks, ask the instructor for help.

8. Replace KEY & FLYWHEEL.

9. Using torque wrench, replace flywheel nut and torque to proper specification.

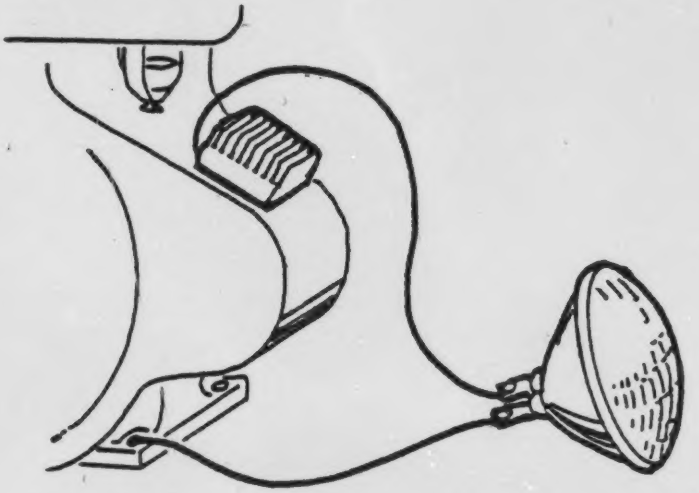


10. Using screwdriver and wrench, replace the flywheel cover or shroud.

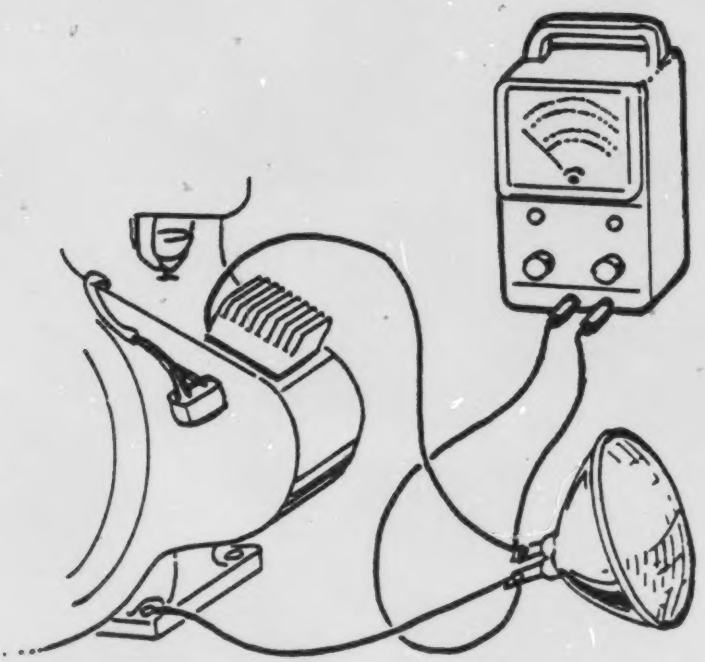
11. Reconnect the spark plug wire.

JOB STEPS

12. Hook up the load lamp, from the charging terminal on the rectifier, and the other side to the block.



13. Using volt-ohmmeter, hook up the volt-meter across the load lamp to read the voltage on the lamp.

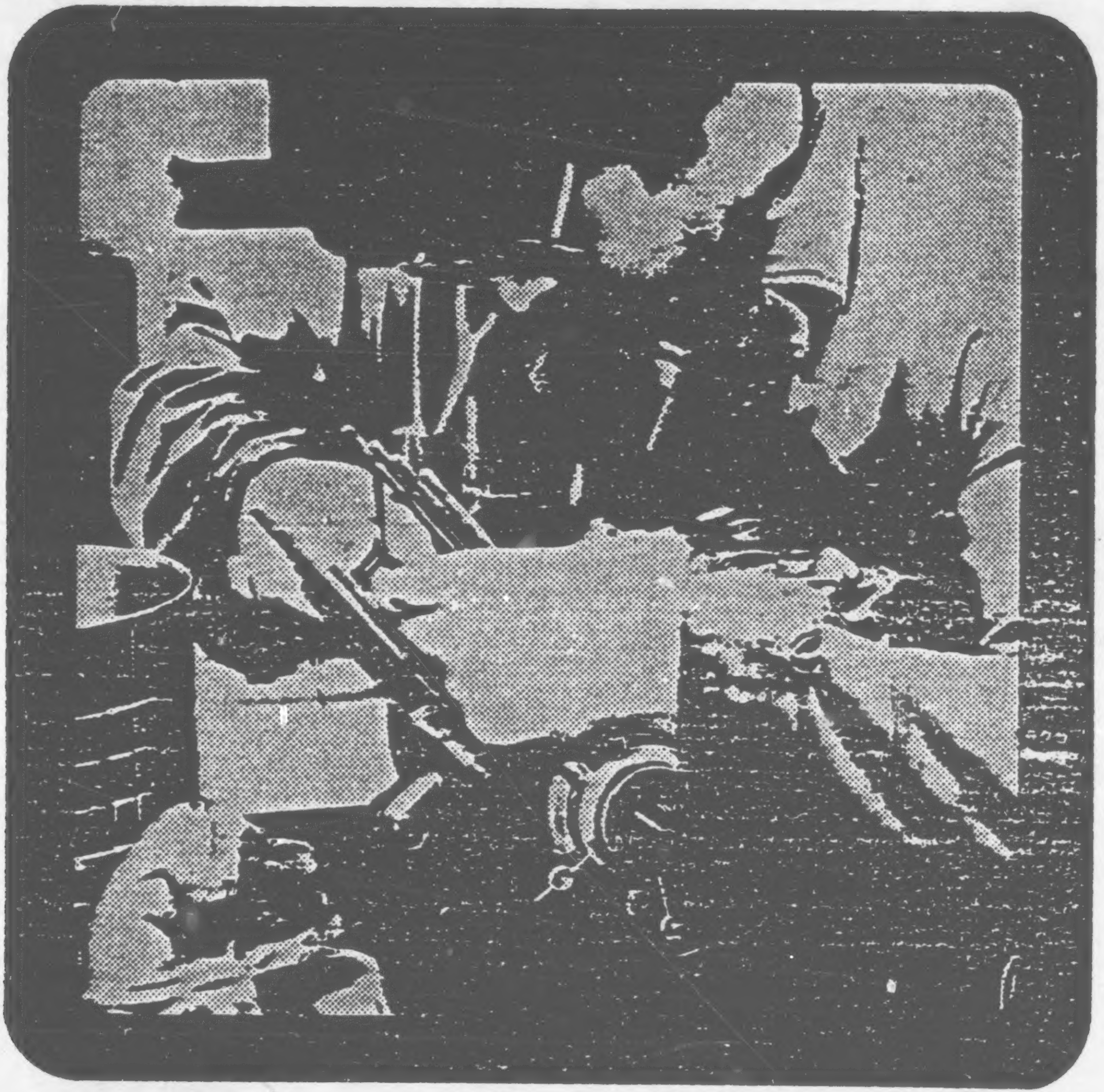


JOB STEPS

14. Start the engine.

15. The lamp should light and the volt meter should show from 8 to 12 volts at varying engine speeds (2400 to 3600 RPM). If you do not get the proper output, check your wiring. If you still don't get proper output, go back and check the rectifier and stator. (See B & S Repair Manual)

16. If everything works well, clean up your tools and your work area.



small engine repair

unit: Electrical

capital area career center

module: 7501 06 003 **date:** 4-14-77 **level:** 2

skill title: Remove Starter or Starter Generator and Check

developed & written by: Dennis Parker

visuals by: Dave Wehrwein

WORD GUIDE

STARTER GENERATOR - a combination of starter and generator in one unit.

STARTER BENDIX or STARTER DRIVE - gear drive that engages with the engine flywheel to start the engine.

PERFORMANCE OBJECTIVE

You are going to learn:

1. How to remove and replace the starter or starter generator.
2. How to check and replace starter brushes, starter bendix, and starter belts.
3. How to test starter and generator system.

And in order to do this you will need:

1 engine (having a starter or starter generator)

1 socket set

1 open end wrench set

1 screwdriver set

1 volt-ohmmeter

1 (60R12) battery or 110V AC starter cord

We will know you can do it when:

The starter or starter generator system on which you've worked, operates according to service manual specification.

INFORMATION

Questions you need to ask before you remove and replace the starter or starter generator:

1. With what make engine are you working?
2. Is the starter AC or DC?
3. Does the starter have a generator built into it?

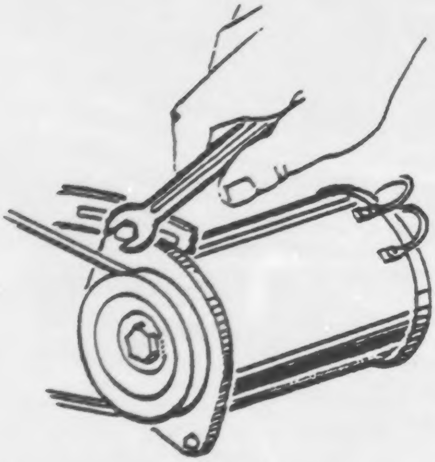
NOW DO:

Read Section 7 in the B & S Repair Manual to check starter, starter motor, starter-generator and engine nameplate.

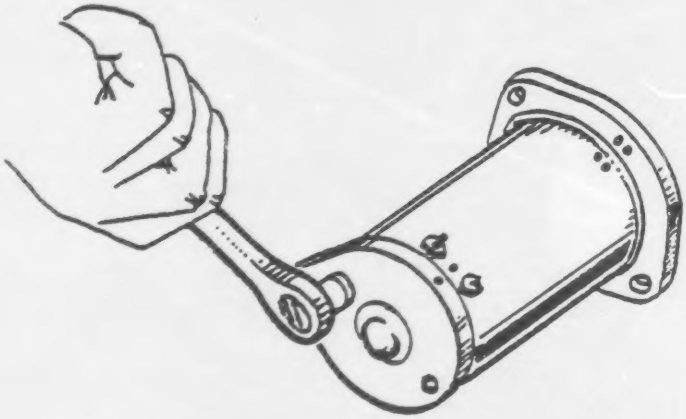
Ask the instructor for help on the parts of the starter or starter generator which you do not understand.

JOB STEPS

1. Check Section 7 of the B & S Repair manual for specifications on your engine starter or starter-generator.
2. Using the screwdriver and socket set, remove starter or starter-generator from the engine.



3. Check starter bendix for wear and check working operation.
4. If your engine has belts, check them for wear or cracking.
5. Use a prick punch to mark the way the starter parts fit back together. Use two marks on one end, and one mark on the other.



WORD GUIDE

ARMATURE - The rotating part of a motor.

JOB STEPS

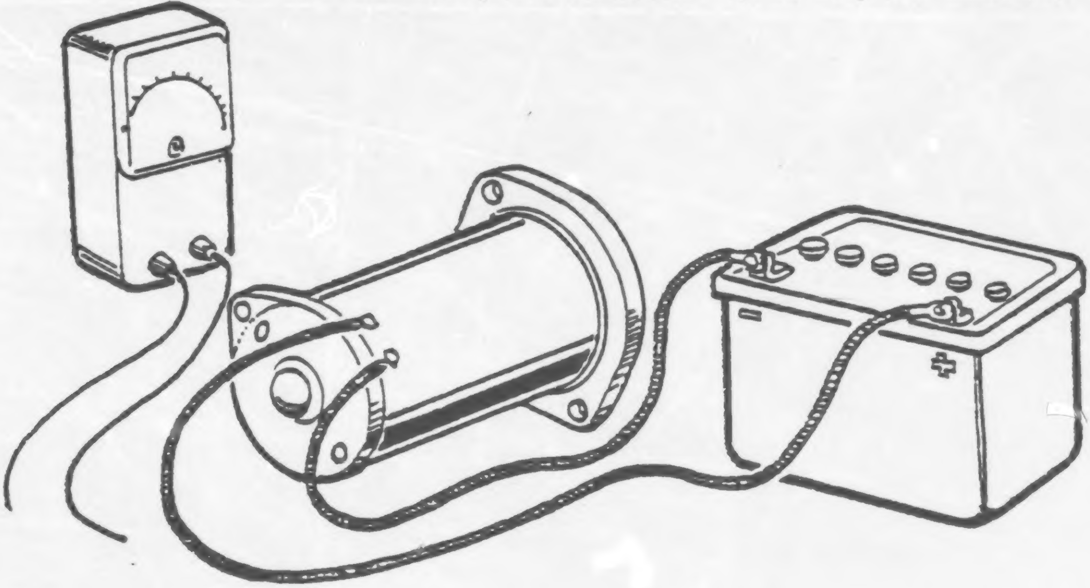
6. Using socket set, remove through bolts and disassemble starter or starter generator. (see repair manual)

7. Check brushes, bearings and armature for wear. If any of the parts are worn, give them to the instructor and get new replacements.

8. Clean all parts and then reassemble the starter.

   NOTE: Be careful not to break any of the wires.

9. Using the volt-ohmmeter, battery or starter cord, test the starter on the bench for performance. (see repair manual)



10. Using socket set, wrenches and screwdriver, install starter on the engine and adjust the belts if they are used. (see repair manual)

11. Check the operation of the starter on the engine. "Is it working well?"

12. Now, using the volt-ohmmeter, check the operation of the generator. (see repair manual)

    NOTE: If you have any questions, ask your instructor for help.

13. Once starter or starter-generator is working according to the service manual, clean up your work area and tools.

JOB STEPS

10. Check the operation of the starter on the engine. "Is it working well?"

11. Now, using the volt-ohmmeter, check the operation of the generator. (see repair manual)

    NOTE: If you have any questions, ask your instructor for help.

12. Once starter or starter-generator is working according to the service manual, clean up your work area and tools.

small engine repair

unit: Electrical

capital area career center

module: 7501-06 004 **date:** 4-18-77 **level:** 2

skill title: Remove, Replace and Install Electrical Parts

developed & written by: Dennis Parker

visuals by: David Wehrwein

WORD GUIDE

TACHOMETER - a meter which reads engine RPM.

ACCESSORIES - additional or attached parts. Parts which relate to other parts.

PERFORMANCE OBJECTIVE

You are going to learn:

How to remove, replace or install electrical accessories such as: tachometers, voltmeters, lighting systems or cigarette lighters, which may or may not be a part of the original equipment of the machine.

And in order to do this you will need:

- a machine (like a riding mower, tractor or snowmobile)
- 1 socket set
- 1 screwdriver set
- 1 open end wrench set
- 1 box end wrench set
- 1 volt meter
- an electrical accessory (tachometer, voltmeter, cigarette lighter or volt/ohmmeter).

We will know you can do it when:

The parts you have replaced or installed work according to the service manual specifications.

INFORMATION

What kind of electrical system are you working with:

a. 6 volt?
b. 12 volt?
c. negative ground?
d. positive ground?

What is the electrical accessory with which you are working

a. lighting system?
b. cigarette lighter?
c. tachometer?

NOW DO:

Read all information on the electrical accessory with which you are working. This information is packed with the accessory.

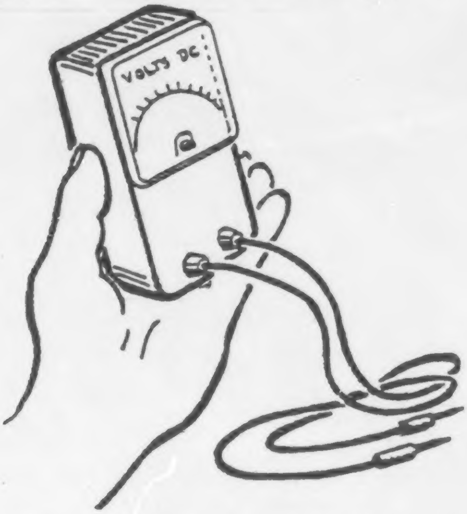
JOB STEPS

NOTE: For broken electrical parts, use steps #1 through #13.

NOTE: For adding electrical parts, use steps #9 through #13.

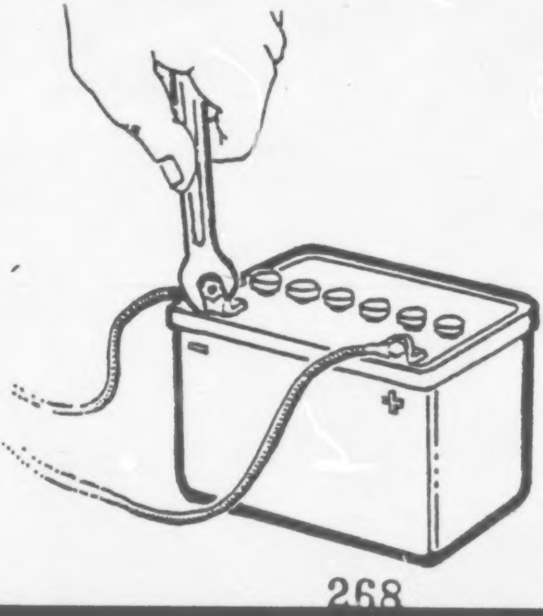
1. Start the machine and, with a voltmeter, check the power supplied to the electrical part.

   NOTE: The Service Manual will tell you what voltage you should find.



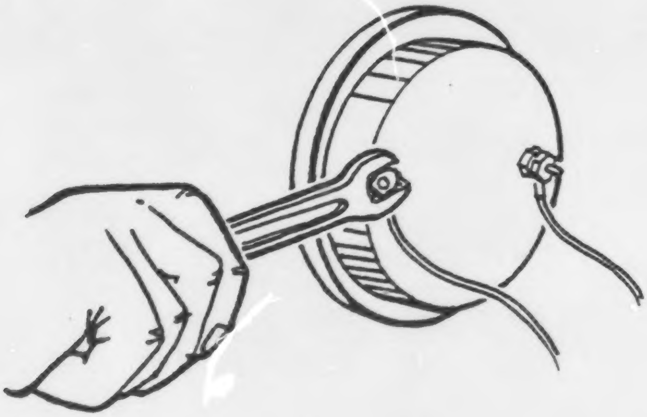
2. If you find zero volts, use Service Manual and check the wiring. Is the fuse blown?

3. If the voltage is correct, turn off the engine and with an open-end wrench, disconnect the battery.



JOB STEPS

4. Using an open-end wrench, remove the wires hooked to the non-working electrical part.



5. Using an open-end wrench, remove the non-working electrical part from the machine.

6. Install the new part and hook up the wires.

   NOTE: Check the Service Manual to make sure the wires are hooked up correctly.

7. Reconnect the battery.

8. Start the engine and check the operation of the new electrical part.

9. Find a place on the machine where you can mount the accessory so it will not interfere with any other parts.

```
***********************************
*                                 *
* CAUTION:  Disconnect the battery *
* before working on the electrical *
* system.  Also, do not wear rings *
* or a watch with a metal band.    *
* Why?  Because you may short cross *
* a wire and cause yourself to be  *
* very badly burned.               *
***********************************
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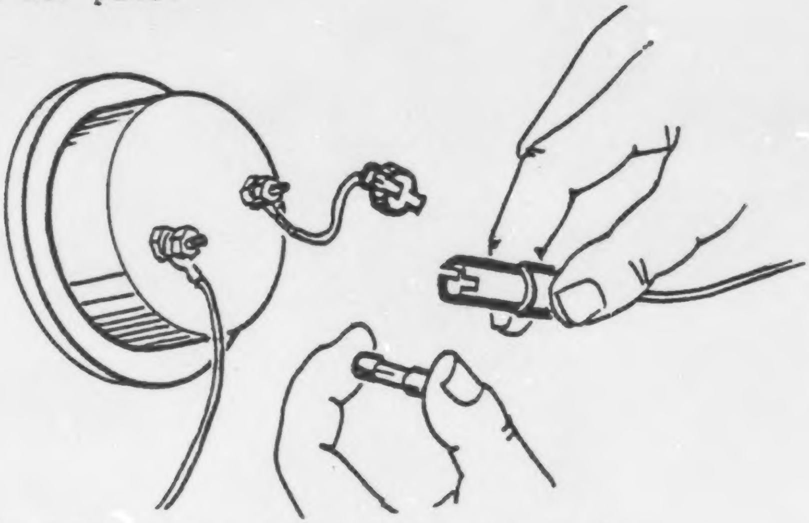
JOB STEPS

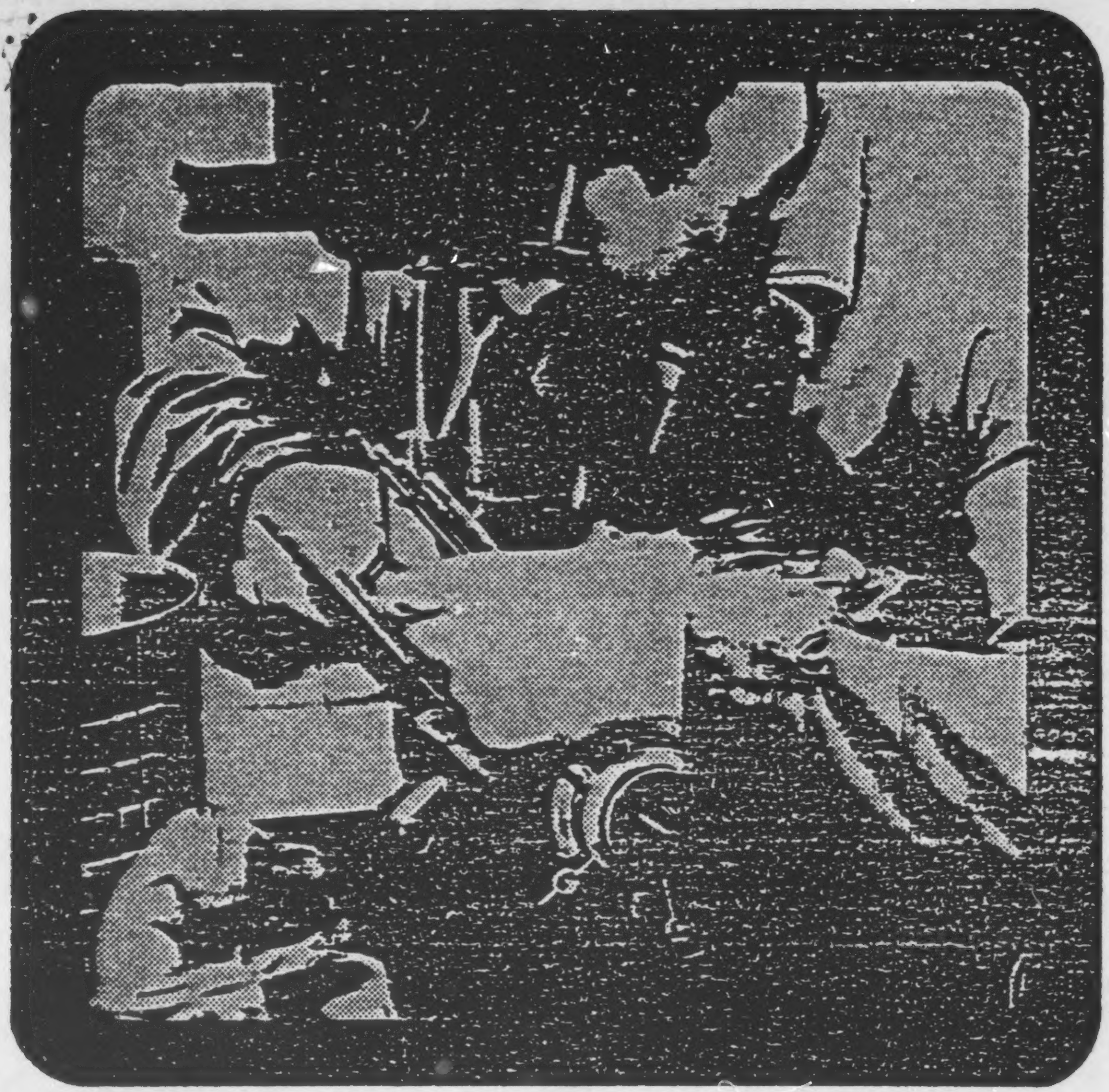
10. Check the Service Manual of the machine to find a place in the electrical system where you can hook-up the new accessory. Does it need a fuse? If so, add the fuse in the wire going to the new part.



11. Reconnect the battery and start the engine.

12. Check the operation of the new accessory.

13. Clean up your tools and work area.



small engine repair

unit: Magnetic Systems

capital area career center

module: 7501 08 002 **date:** 2/77 **level:** II

skill title: Remove, Replace, And Check Flywheel, Points, Condenser And Coil

developed & written by: Dennis Parker

visuals by: Dave Wehrwein

WORD GUIDE

MAGNETO - An engine driven device that generates it's own high voltage to fire the spark plug. It needs no outside source of power to work.

IMPACT NUT - A tool used for removing the flywheel, when a puller is not available.

B & S - Briggs and Stratton

PERFORMANCE OBJECTIVE

You are going to learn:

How to remove and check the flywheel and all magneto parts, (including the coil, condenser, breaker points, breaker point cam, and breaker housing dust cover) and then reinstall the parts on the engine and make it run.

And in order to do this you will need:

- An engine
- A socket set
- A screw
- A torque wrench
- A coil-condenser tester
- A flywheel puller or impact nut
- Special B & S tools
- A set of feeler gauges

We will know you can do it when:

The engine you worked on has enough spark to jump a .166 gap on the tester.

INFORMATION	MATERIALS	LOCATION OF MATERIALS
What's the make of engine you have? Check the engine name plate		
What model engine is it? Check the model number on the name plate.		
NOW DO		
Read the ignition section of the manual that tells about your engine.	B & S Repair Manual	Section II
	Small Engine Service Manual	p. 21-25
NOTE: Be sure you know the function of the coil, condenser, and breaker points.	Small Engine Service Manual	p. 21-25
	B & S Manual	Section II

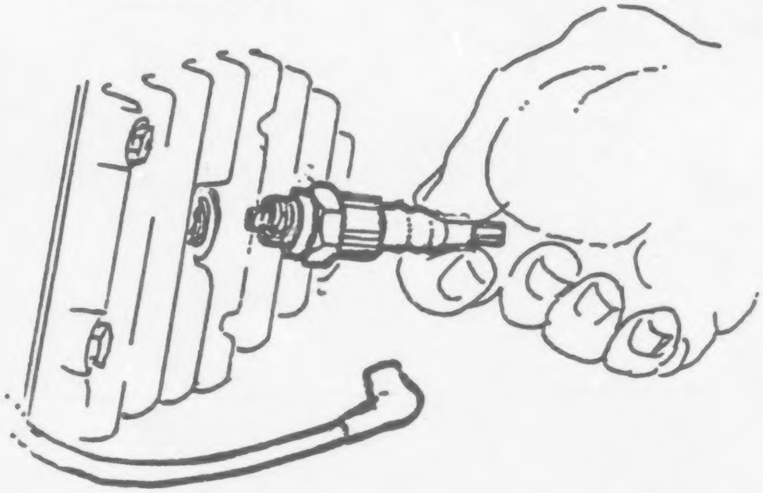
WORD GUIDE

BLOWER SHROUD - The sheet metal covering around the flywheel.

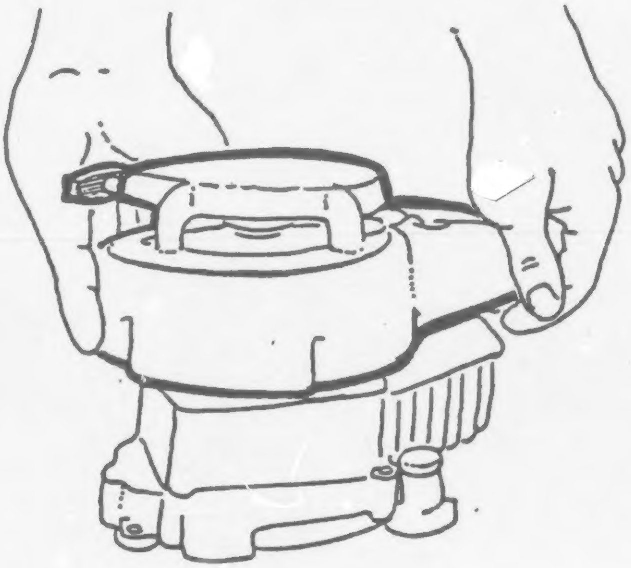
JOB STEPS

1. Check the service manual for the specifications on your engine.

WARNING: Before starting to work on the engine, Remove The Spark Plug.

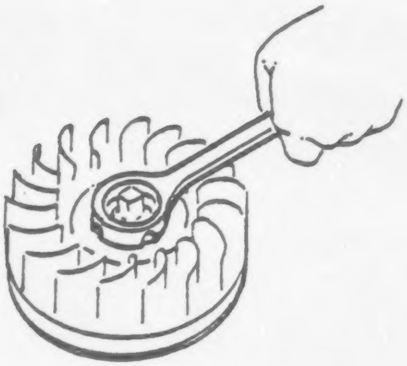


2. Remove the engine blower shroud.

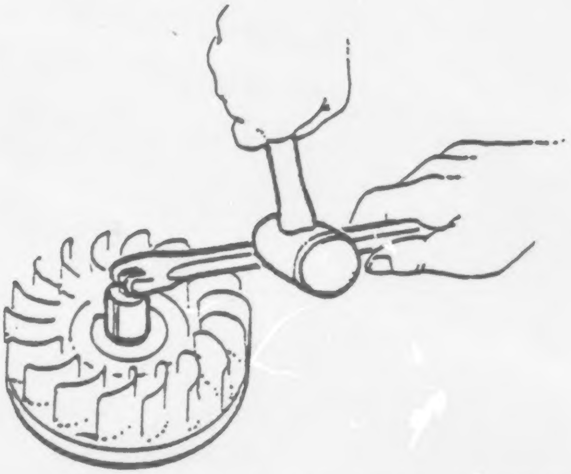


JOB STEPS

3. Remove the flywheel nut or starter clutch, depending on the model engine.

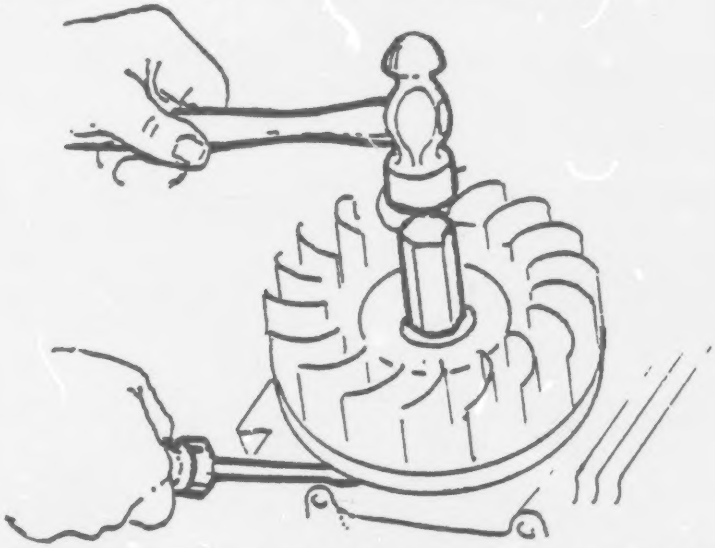


nut

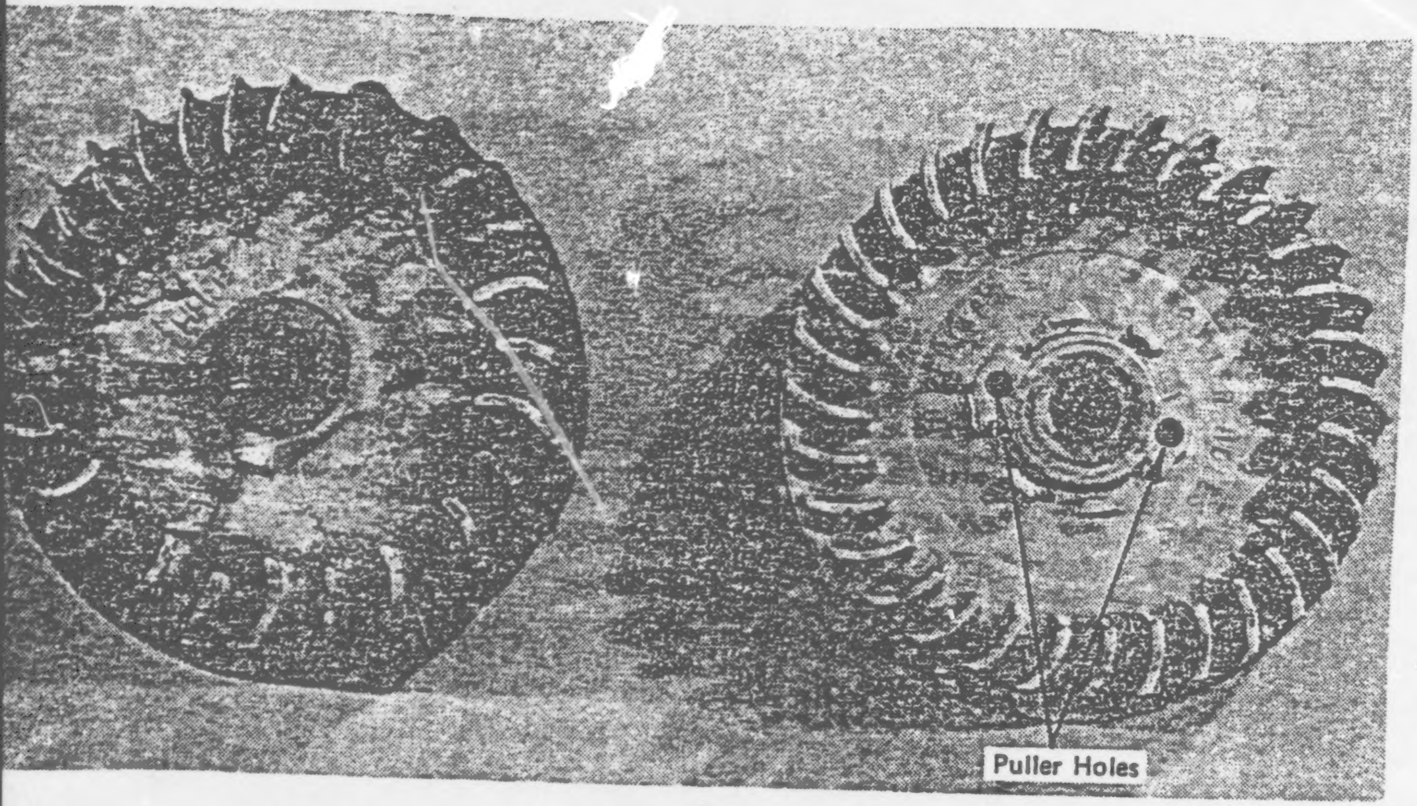


starter clutch with spanner wrench

4. Remove the flywheel; do this by using the proper puller, (check the B & S Repair Manual for use of the puller) or impact nut and a hammer. To use the impact nut, slip it over the stub end of the crankshaft and rap it with the hammer.

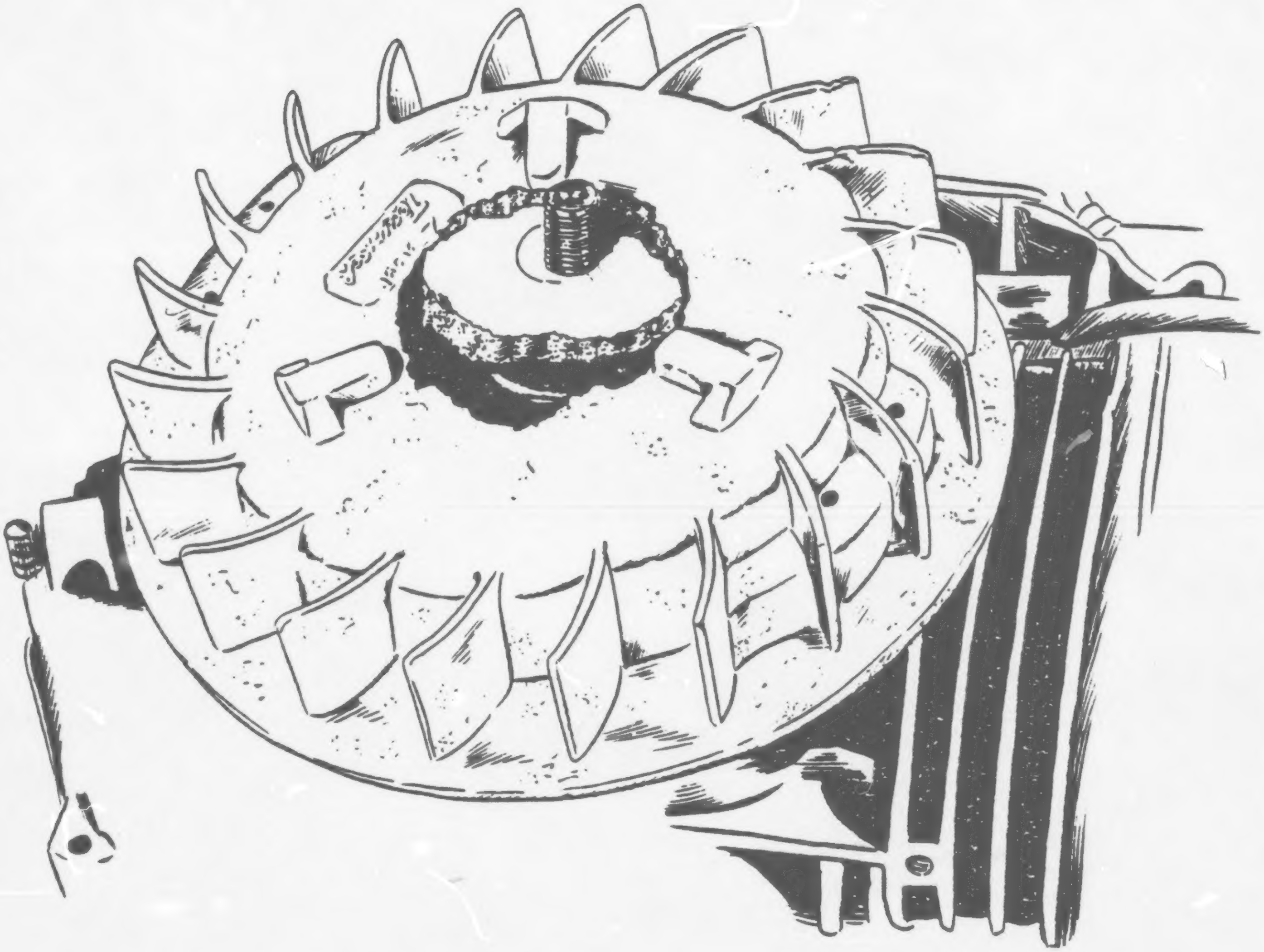


NOTE: Ask the instructor for help if you do not understand how to use the impact nut or flywheel puller. Improper use of either may result in damage to the flywheel or crankshaft.

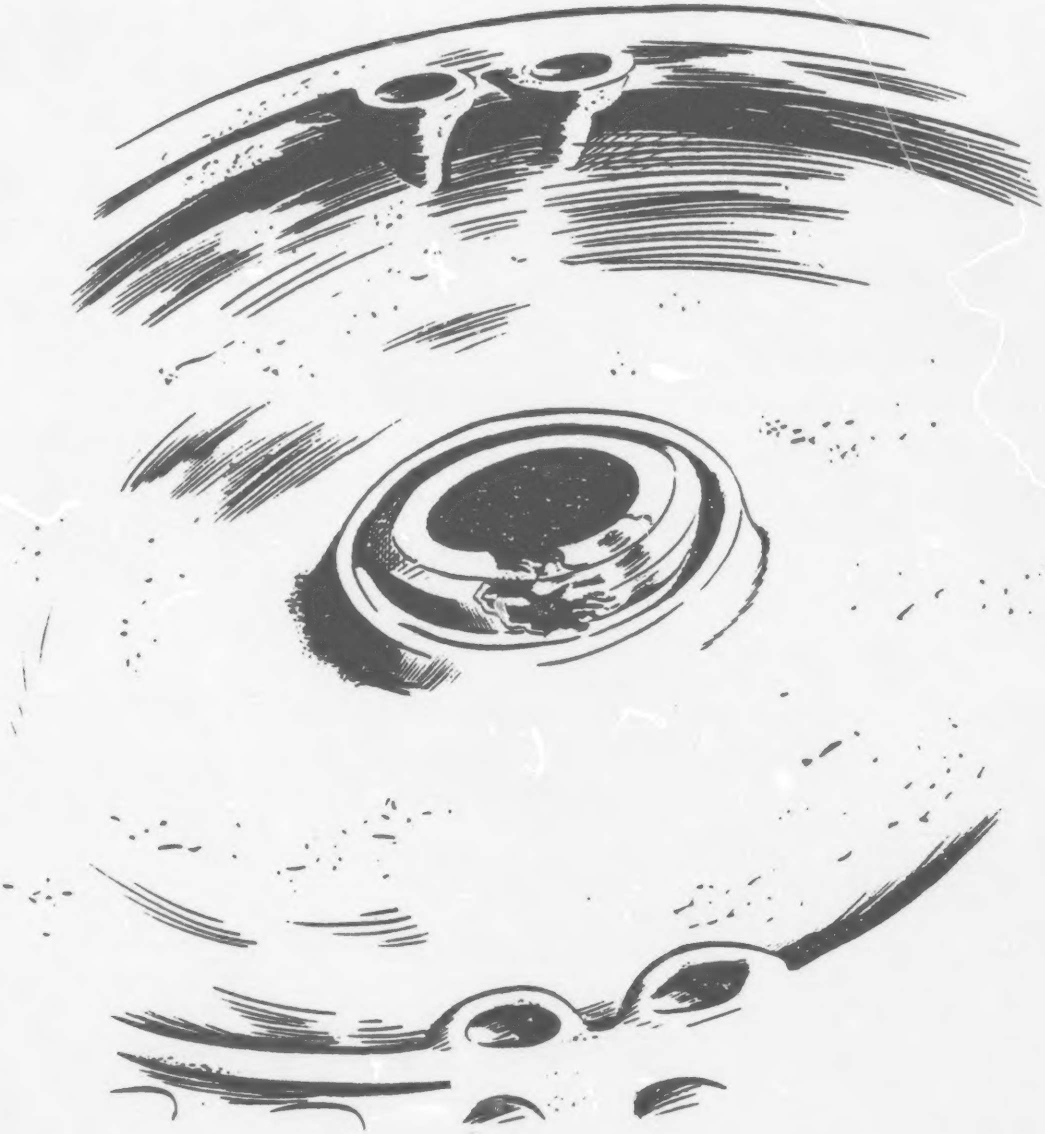


These two flywheels go on Briggs and Stratton engines. The flywheel on the right has puller holes; the one on the left does not.

Flywheels on Briggs and Stratton engines are very easily removed by using an impact tool.



FLYWHEEL DAMAGE
(caused by using wrong puller)

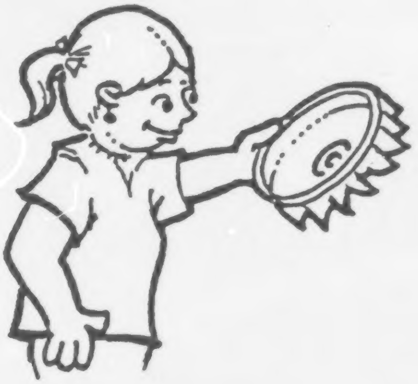


KEYWAY DAMAGE

(caused by wrong type key,
loose nut, or hitting a
solid object with the blade.)

JOB STEPS

5. Check the flywheel for rubbing or cracks; also check the flywheel keyway for wear or any type of damage (see figure of keyway damage below).



6. Remove the key with a screwdriver and check it for wear. It should fit the crankshaft and flywheel snugly.

7. Remove the dust cover over the breaker points and condenser. Check the cover for dents or signs of rubbing parts (usually the cover is located under the flywheel).

8. Rotate the crankshaft to see if the points are opening. Leave the crank in a position where the points are open.

9. Remove the points and condenser. Be careful with the wires!

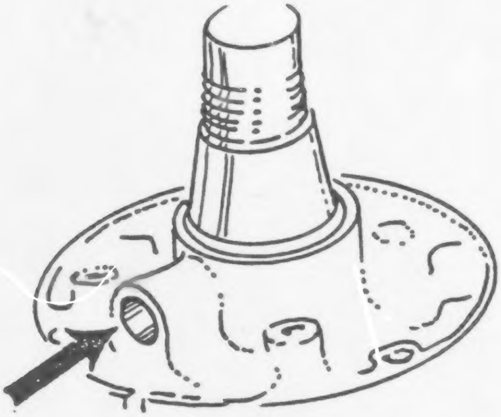
10. Remove the coil. Check the wires for rubbing on the flywheel and cracks (if it is damaged, give it to the instructor and get a new one). Test the coil to see if it's good (use mod 7501 13 002 and 7501 13 003).

11. Test the condenser using the coil-condenser tester (use mod 7501 13 001).

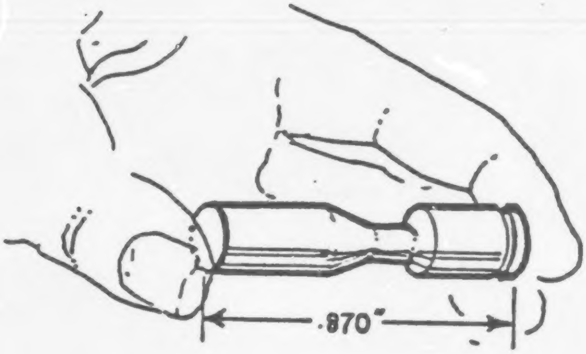
12. Put the condenser back in the engine if it tested O.K. If it didn't, give it to the instructor and get a new one. Test the new one before you put it in.

JOB STEPS

13. Inspect the breaker point cam (if possible) for dirt and cracks or wear. See that it is installed in the proper way.



14. Inspect plunger for wear and proper length (must be at least .870 long). Insert with groove at top or oil will enter breaker box.

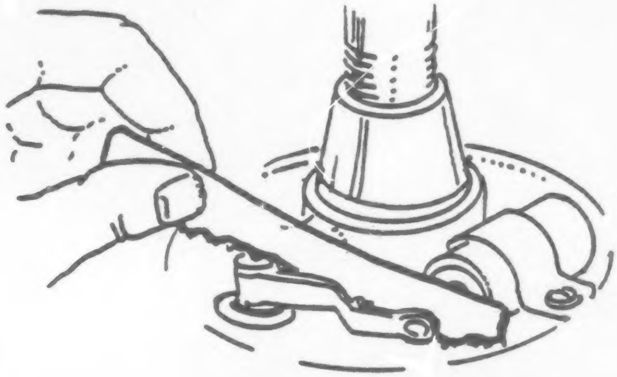


15. Check the breaker points for pitting or burnt spots (if they are bad get a new set from the instructor).

16. Install the points in the engine and set them to the proper point gap (look in the service manual for the right setting).

JOB STEPS

17. Rotate the crankshaft until the points are closed. Now pull a piece of lint-free paper (notebook paper) through the points to clean them.



18. Put the coil back on your engine.

NOTE: If the coil is located under the flywheel, the air gap, or distance between the coil and flywheel is preset and cannot be adjusted.

If the coil mounts outside the flywheel, the air gap is adjustable. Pull the coil back away from the flywheel and tighten one of the hold-down screws.

19. Hook up all the wires. Check that they are routed like they were before you removed them.

20. Install the flywheel. Don't forget the key.

21. a) Rotate the flywheel until the magnets are pointed toward the coil.

    b) Put a feeler gauge of the proper thickness (.010 unless otherwise specified in the service manual), between the coil and the flywheel.

    c) Loosen the bolt, holding the coil tight, and let the flywheel magnets pull the coil to the flywheel.

    d) Tighten all the bolts on the coil and remove the feeler gauge.

JOB STEPS

22. Put the plug wire on the B & S spark tester (see B & S Repair Manual, Section 3, page 1).

23. Spin the flywheel in the right direction and watch the spark. If it is blue or orange, it is O.K. If it is yellow, repeat steps (blue spark is the best).

24. Replace spark plug and hook up spark plug wire.

25. Replace the blower shroud.

26. Check engine oil level and fuel.

27. Start the engine and check it's operation for smoothness of idle and acceleration.

28. Clean up your tools and work area.

small engine repair

unit: Magnetic Systems

capital area career center

module: 7501 08 003 date: 3/29/77 level: 2

skill title: Remove and Replace Armature Plate Assembly and Retime Engine (Tecumseh)

developed & written by: Dennis Parker

visuals by: Dave Wehrwein

WORD GUIDE

ARMATURE PLATE ASSEMBLY - The side cover of the engine which holds the magneto assembly. Located under the flywheel.

DIAL INDICATOR - Instrument used to show the position of the piston in the engine.

MERCOTRONIC TESTER or OHMMETER - Used to show when breaker points are closed.

PERFORMANCE OBJECTIVE

You are going to learn:

How to remove, check and replace the armature plate assembly; to retime armature plate assembly to engine using a dial indicator and a continuity light.

And in order to do this you will need:

1 engine

1 socket set

1 dial indicator

1 set open end wrenches

1 mercotronic

1 feeler gauge set

1 screwdriver set

1 flywheel puller or impact nut

We will know you can do it when:

The points will open according to the service manual specifications.

WORD GUIDE

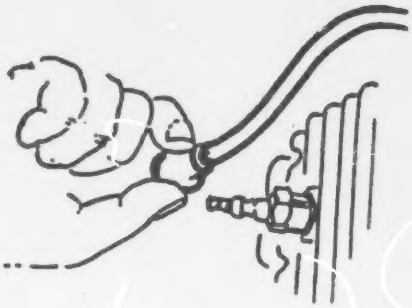
MAGNETO - an engine-driven device that generates its own high voltage to fire the spark plug. It needs no outside source of power to work.

INFORMATION	MATERIALS	LOCATION OF MATERIALS
What brand engine are you working on?		Engine Nameplate
What is the model number?		
NOW DO:		
Understand the function of the flywheel in relation to the magneto.	Small Engine Service Manual	Ignition Sys. Fundamentals Pages 7-16
Read: Spark Plug Servicing, Small Engine Service Manual, page 24. Be able to check the condition of the engine by looking at the spark plug.	Small Engine Service Manual	Page 24

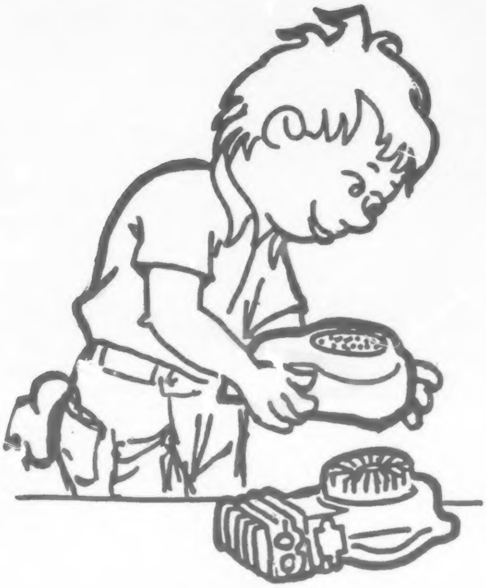
JOB STEPS

1. Check service manual for specifications on your engine.

```
**********************************
*                                *
* WARNING:  Before starting to   *
* work on the engine, remove     *
* the spark plug wire            *
**********************************
```



2. Remove engine blower shroud.

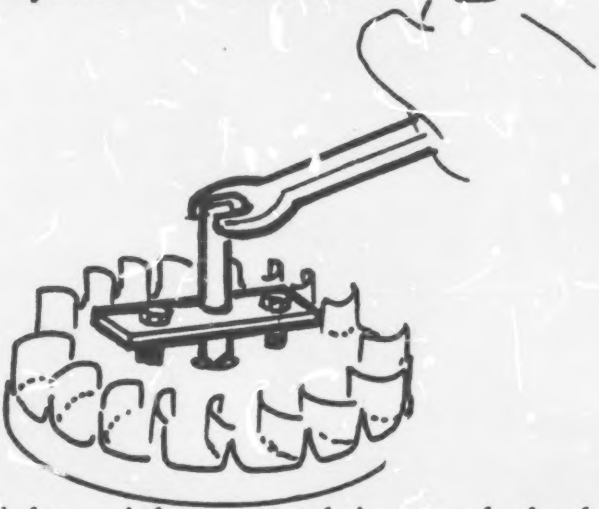


WORD GUIDE

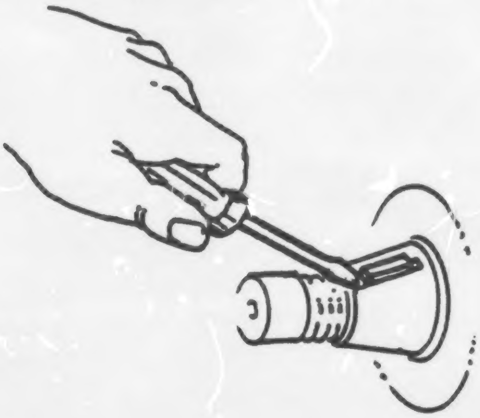
WEAR - Damage to loose flywheel or hitting solid object with blade.

JOB STEPS

3. Remove flywheel nut and flywheel with a flywheel puller or impact nut. If you do not understand how to use the impact nut or puller, ask the instructor. Improper use of either tool may result in damage to the flywheel or crankshaft.



4. Remove flywheel key with a screwdriver and check it for wear. Also check flywheel keyway for wear or damage.

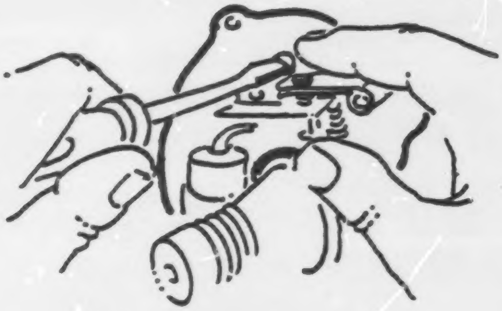


WORD GUIDE

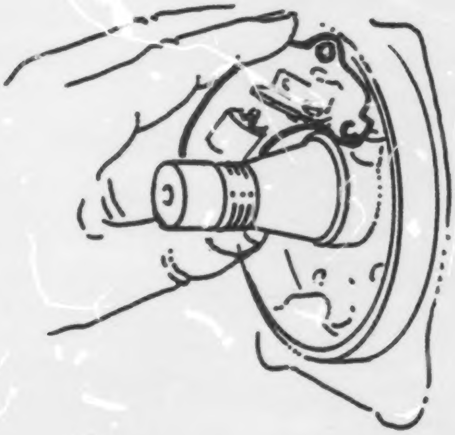
DISTORTION - Changes from original state, like twists.

JOB STEPS

5. Remove the armature plate or stator assembly and check it for cracks or distortion.

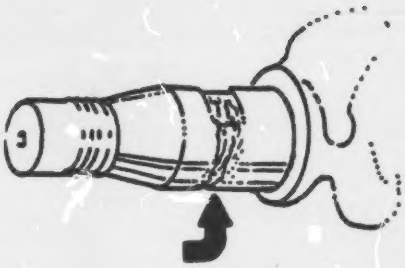


6. Replace the stator assembly on the engine. Do not tighten it.

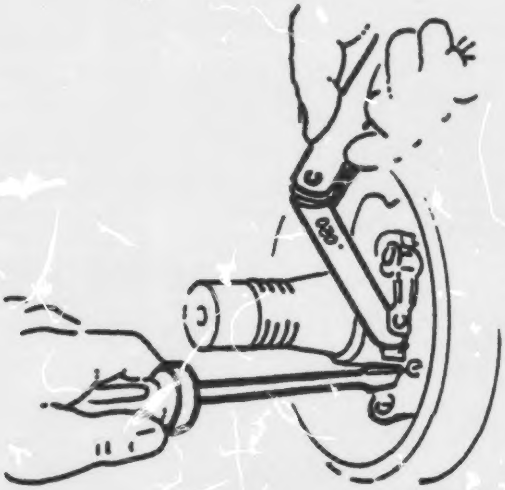


JOB STEPS

7. Check the breaker cam for wear or cracks. If it is damaged, get a new one.

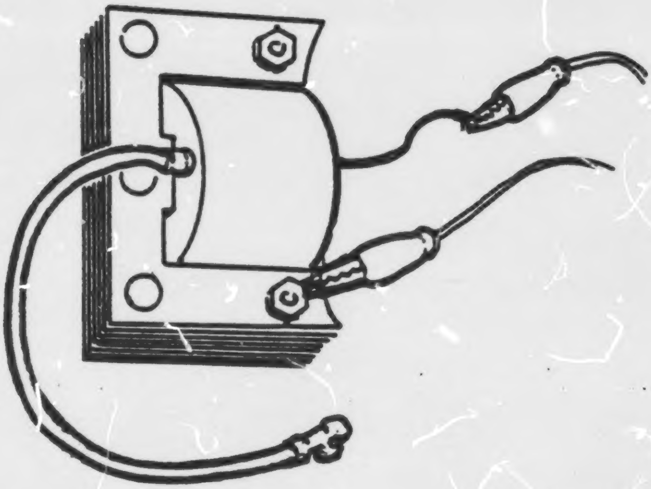


8. Set the breaker points for proper opening. Check the manual. Set all points at .020 unless otherwise stated on the stator plate or cover (Tecumseh).

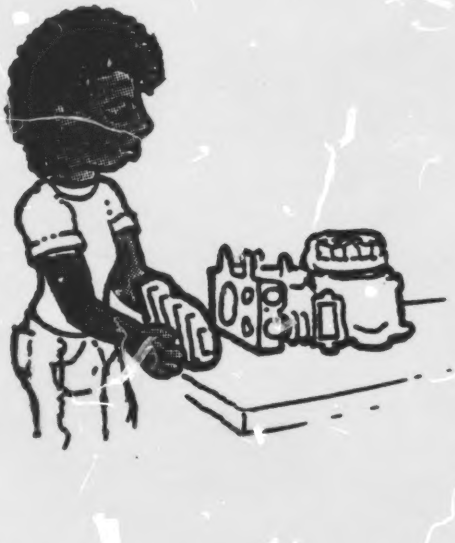


JOB STEPS

9. Check the magneto coil for cracks. Check operation with Mercotronic tester.

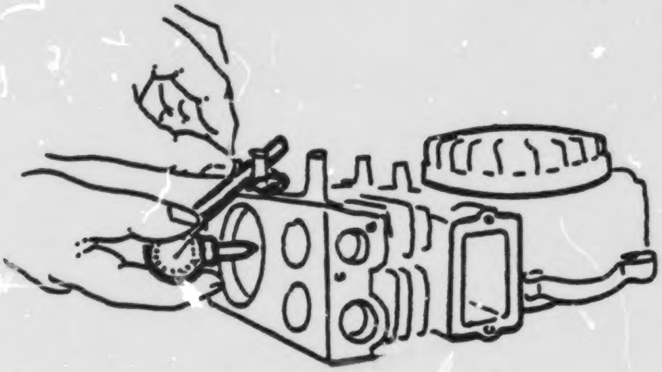


10. Remove the head.

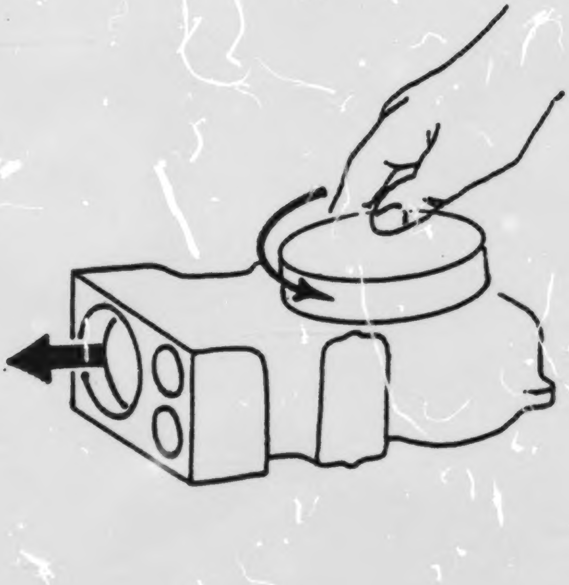


JOB STEPS

11. Install dial indicator. Be careful with the indicators because they break easily.

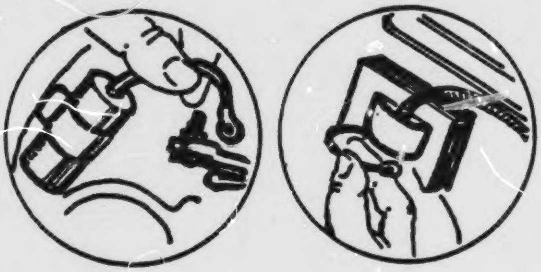


12. Rotate the crankshaft to the point where the indicator reads the highest. This is "top dead center" of the piston in the cylinder: "0 degrees". Set the dial indicator for "0".

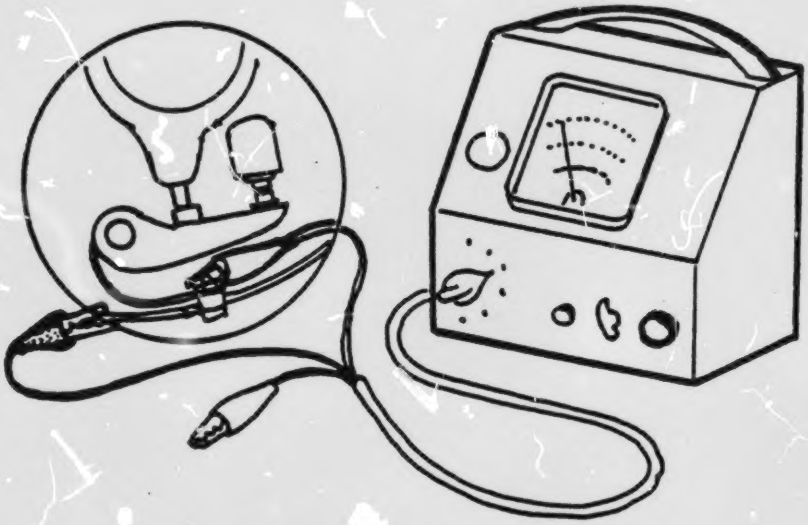


JOB STEPS

13. Disconnect coil and condensor wire from the points.



14. Hook up the mercotronic small red lead wire to the point terminal. Hook small black wire to ground.



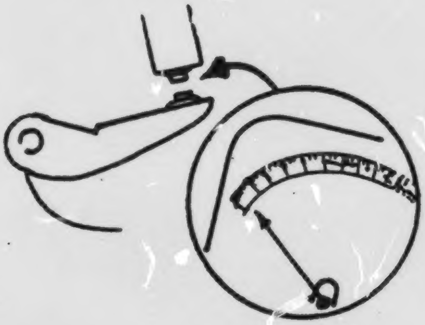
WORD GUIDE

COUNTER-CLOCKWISE - Direction opposite that of hands on a clock; to the left.

CLOCKWISE - To the right, like hands on a clock.

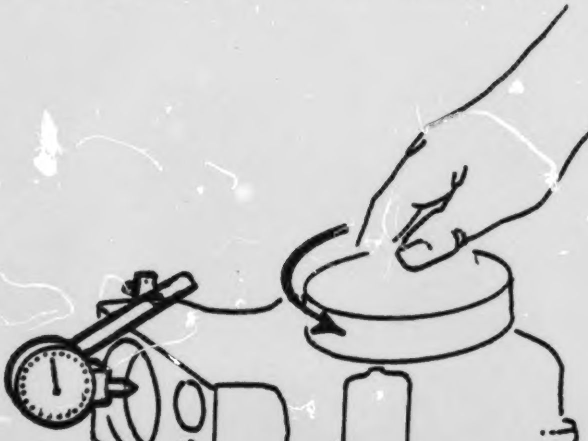
JOB STEPS

15. Turn dial to #3 position. Check to see if points are open or closed.



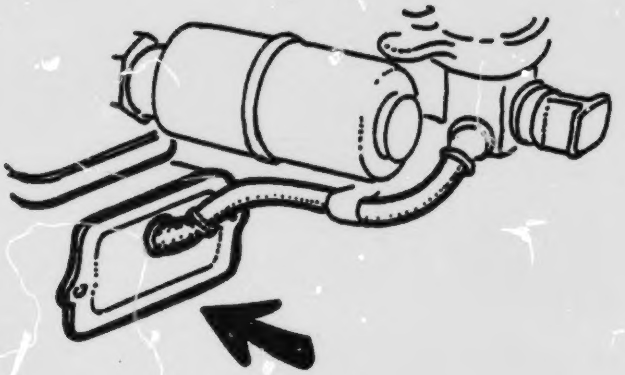
NOTE: If you do not understand the use of the mercotronic, ask the instructor for help.

16. While watching the dial indicator, rotate the crankshaft counter-clockwise until the indicator reads the number of thousandths-of-an-inch at which the timing on your engine should be set. Check the service manual for the proper setting.

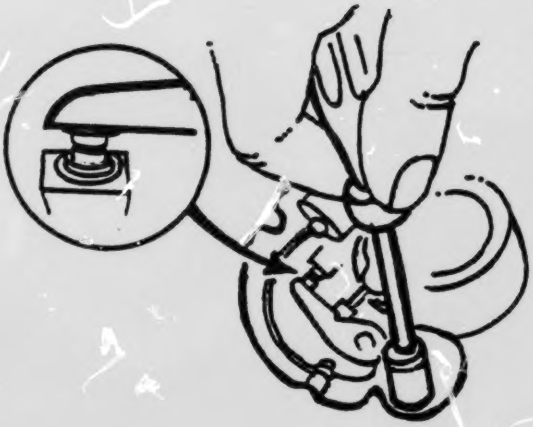


JOB STEPS

17. Rotate the armature plate until the points just open. (The needle will move to the left of the dial and tighten down the plate.)



18. Rotate the crankshaft farther counter-clockwise, then clockwise, until the points open according to the mercotronic. Dial indicator will show if points open at correct number of thousandths. If they do not, go back to step 17.



JOB STEPS

19. Remove the dial indicator and the mercotronic.

20. Re-install coil and condensor wires.

21. Install flywheel key and flywheel.

22. Install flywheel nut and torque to proper specifications. (See the service manual)

23. Install a new gasket and head on the engine. Torque to proper specifications.

24. Replace engine blower shroud.

25. Check engine oil level and fuel.

26. Replace spark plug wire.

27. Start engine. Adjust idle and check smoothness of acceleration.

28. Let engine run 5 minutes, and re-torque head.

29. Clean up your work area and tools.

small engine repair

unit: Lubrication

capital area career center

module: 7501 09 001 date: 6/77 level: III

skill title: Check Service Manual for Lubricating, Lubricate Machine, Change Oil, and Service with Proper A.P.I. Rated Lubricant, and Change Engine and Transmission Oil Filters

developed & written by: Jim Pitts

visuals by:

WORD GUIDE

A. P. I. - American Petroleum Institute.

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

1. How to check service manual lubrication specifications.
2. How to lubricate machine, change oil, and service with proper A. P. I. rated lubricant.
3. How to change engine and transmission oil filters.

IN ORDER TO DO THIS YOU WILL NEED:

1. A machine with 2 or 4 cycle engine
2. Socket
3. Open end wrench set
4. Screwdriver set
5. Service or owners manual.

WE WILL KNOW YOU CAN DO IT WHEN:

You have changed the transmission and engine oil and filters, and then lubricated the engine according to service manual specifications.

INFORMATION

Fill in this information about the engine on which you are working. Do not write on this sheet. Use scrap paper.

What make engine: ______________________________

What model: ____________ Type: ________________

What serial number: _________________

What type carburetor? Float _______ Diaphram _______

Suction _________ Automatic choke ____________

Is engine vertical _______ Horizontal ____________

2 cycle ____________ 4 cycle ______________

What type starter? Rewind top mount __________

Rewind side mount _______ Wind up ________

Electric starter ________ 12 volt ________

Rope and pulley ________ 110 volt _______

What type air filter: _____________________

Kind of transmission: _____________________

Type of transmission oil: __________________

What type oil: ___________________________

You can find this information in the service manual for the kind of engine you have. If you do not use the proper lubricants in the engine, you can ruin the parts in the engine.

WORD GUIDE

GREASE ZERK - Same as grease fitting.

TRANSMISSION - A device that uses gearing or torque conversion to effect a change in the ratio between engine RPM and driving wheel RPM.

JOB STEPS

THINK SAFETY!! WORK SAFELY!!!

1. Check on nameplate to see if it tells which type of oil is used in the crankcase. If there is an owner's manual available, check there. Be sure to use the right manual for the engine you have.
2. Lock in owner's manual to see where grease zerks are located. If a manual is not available then check engine to see if there is a grease fitting wherever any parts turn. If there is no grease fitting, just oil the turning parts. If it is a chain, oil it with a good chain lube.
3. If the transmission is an automatic or hydraulic drive type, there will probably be an oil filter. Follow the steps in the owner's manual.
4. If the transmission is standard shift, get an owner's manual to see what gear lube you must put into the transmission.

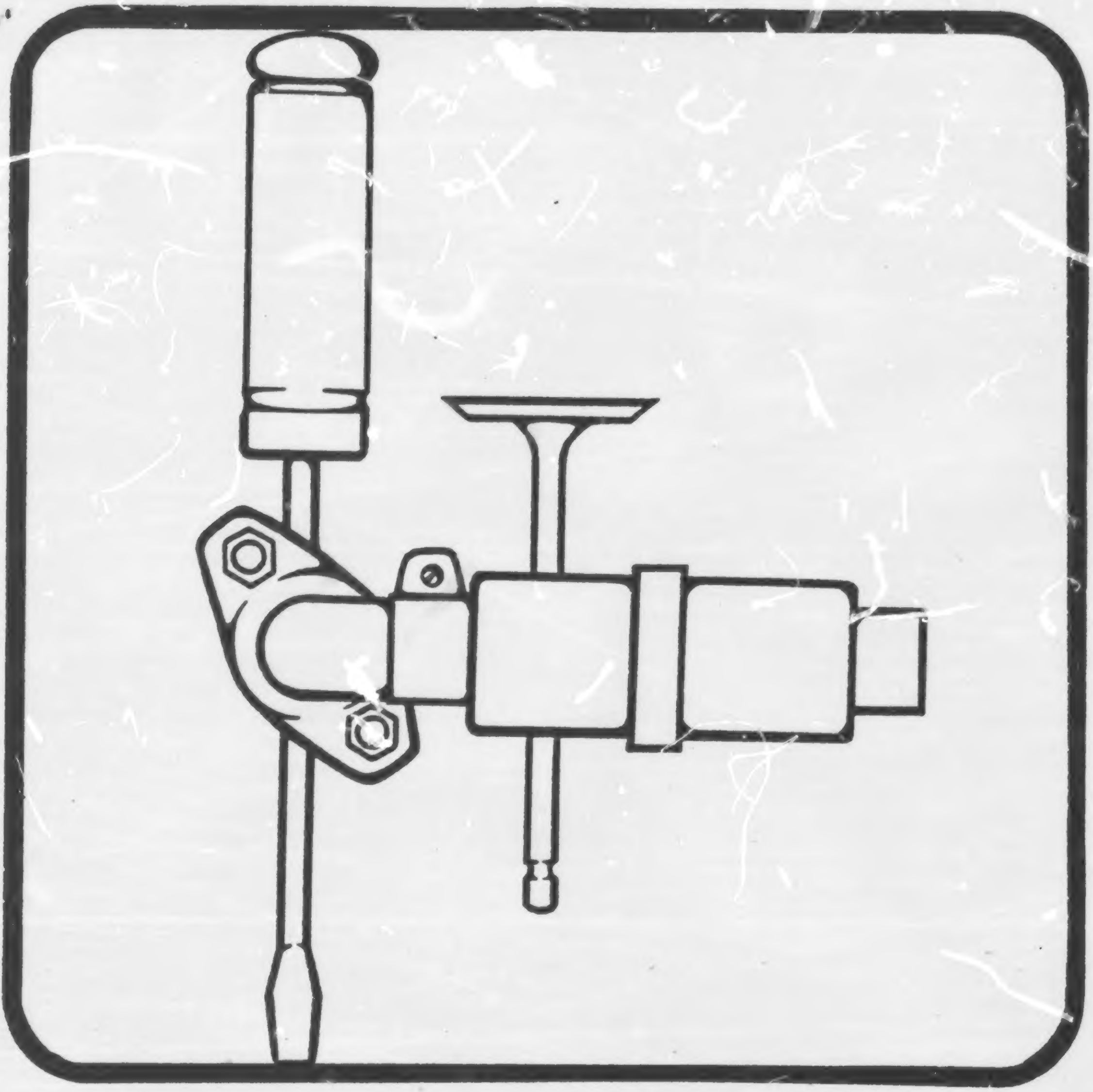
   NOTE: The transmission may be sealed, so you can't change it or add oil to it.
5. Before changing the oil in the engine, check it to see if oil is at a safe level so you can run the engine. Start the engine and allow the oil to warm up before changing it.

WARNING: Before starting the engine, observe all the normal rules such as transmission in neutral, blades out of gear, etc. Stop engine after five minutes.

6. Remove the oil plug. Drain the oil into a pan.
7. Replace the oil plug and be sure it is tight before going on to the next step.

JOB STEPS

8. Refill crankcase with proper weight and amount oil. Double check the oil plug to be sure it is tight.
9. Next, you should clean the air filter before sending the unit back. Refer to Mod 7511 02 001.
10. Clean up for customer pick-up.
11. Ask the instructor to check your work.



small engine repair

unit: GEAR BOXES AND DRIVE TRAINS

capital area career center

module: 7501 10 001 date: June 1977 level: I

skill title: Remove and Replace Transaxle John Deere Tractor (200 Series)

developed & written by: Paul Loukides

visuals by: Dave Wehrwein 300

WORD GUIDE

TRANSAXLE: A unit consisting of a transmission and a differential axle.

VARIATOR: A pulley with an adjustable sheave for speed control.

SHEAVE: Grooved wheel

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to remove and replace the transaxle on a John Deere 200 series Tractor.

IN ORDER TO DO THIS YOU WILL NEED:

John Deere Tractor, 200-series
1 socket set
1 open end wrench set
1 box end wrench set
1 pliers
Automotive Jack
Blocks or holding frame
Safety glasses

WE WILL KNOW YOU CAN DO IT WHEN:

You have replaced the transaxle and other disconnected parts according to the service manual specifications.

INFORMATION

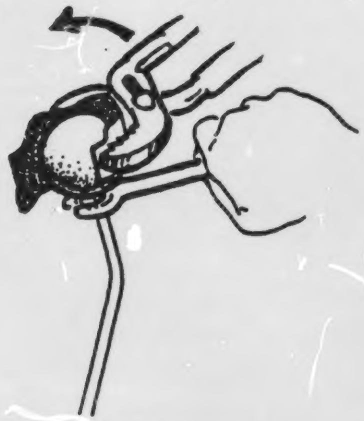
Transansaxles on other units such as those made by Tecumseh/ Peerless may be removed and replaced somewhat differently. If in doubt, consult the repair manual for the particular machine on which you are working.

JOB STEPS

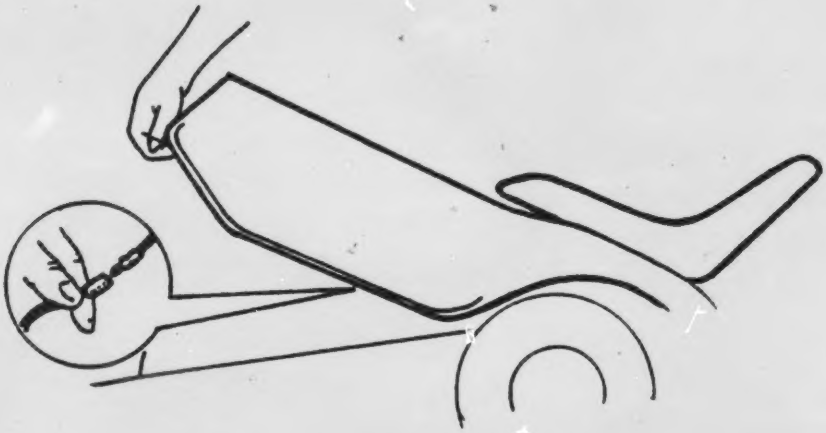
1. Remove fender-deck. WEAR SAFETY GLASSES.

   A. Remove 4 bolts - 2 in front. 2 in back.
   B. Remove 2 foot pedals.
   C. Unscrew the handle tops:

      1) Protect knob with a rag and loosen with pliers.
      2) Hold handle nut with a wrench.



   D. Put gear shift in neutral.
   E. Drop blade (handle on left side).
   F. Have someone help you pull up on sides of fender-deck, using pedal holders for grip.
   G. While someone holds up fender-deck, remove electric wire to seat sensor.



   H. Pull the fender-deck backward.

****

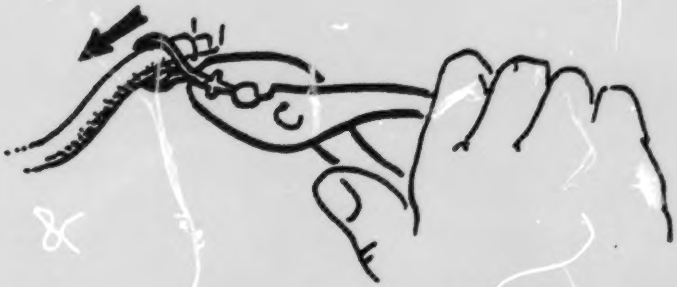
CAUTION: Don't lose the black spacer on the front left side.

****

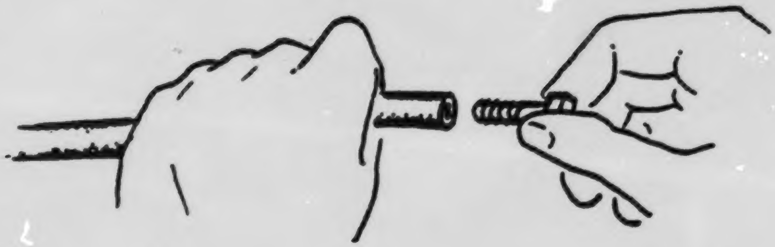
JOB STEPS

2. Follow the steps below to remove and drain fuel tank:

   A. Remove 2 bolts on side of tank.
   B. Shut off gas valve under the tank by twisting valve to the left.
   C. Use pliers to remove gas line clamp.



   D. Put a bolt in gas line to keep excess gas from running out.



   E. Watch where gas line is placed over the transmission. It must be put back in the same place.

NOTE: Put fuel in approved containers only.

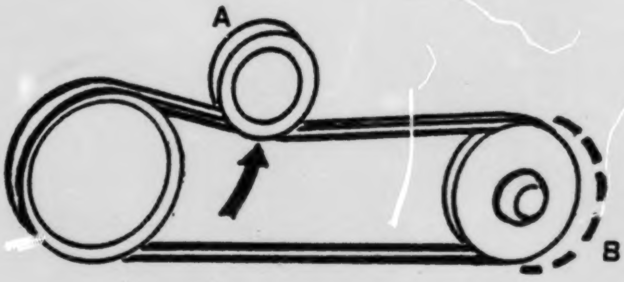
JOB STEPS

3. Follow these steps to remove secondary belt:

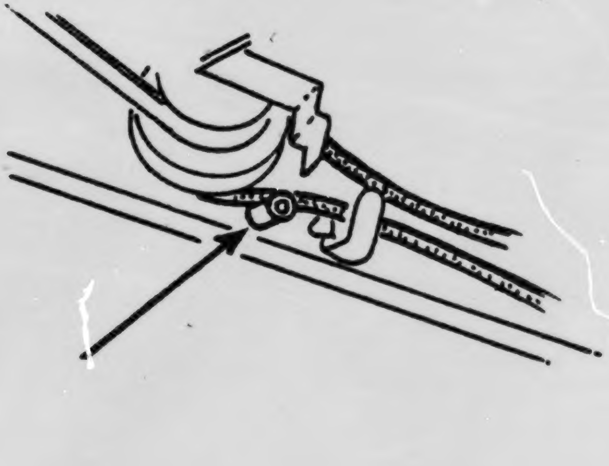
A. Start the engine and move the variable speed control lever to the forward position.

CAUTION: Engine must be running, and gear must be in NEUTRAL.

B. Raise the secondary belt idler (A) and slip secondary belt (B) off variator.

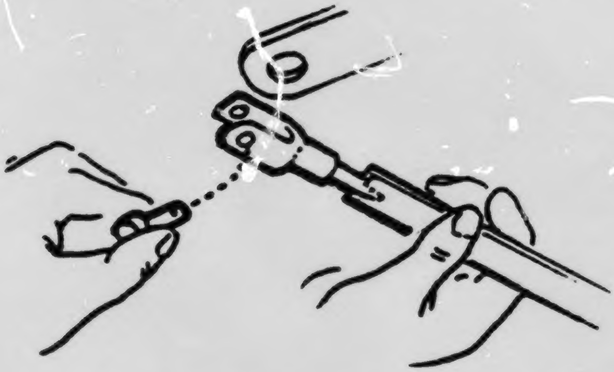


C. Push in clutch pedal so that secondary belt can be pulled past brake pedal shaft.

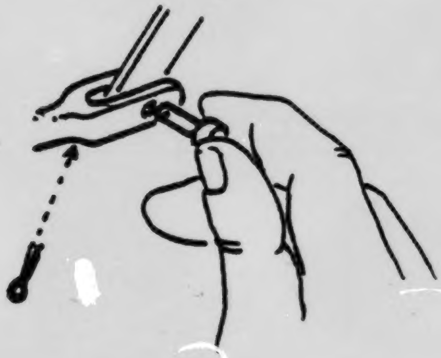


JOB STEPS

4. Remove cotter pin and drilled pin from brake arm.



5. Remove cotter pin from brake pedal linkage to cross shaft.



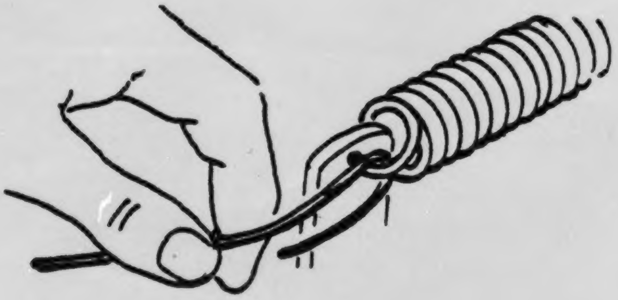
6. Remove idler pulley tension spring by following these steps:

****

CAUTION: Don't let spring fly away. It is under lots of tension.

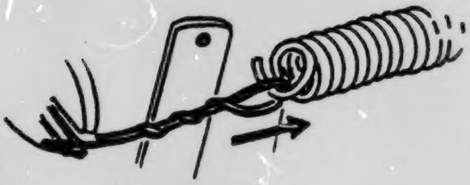
****

A. Hook some stiff wire to the spring end so you can let it back easy and keep it hooked on bracket.

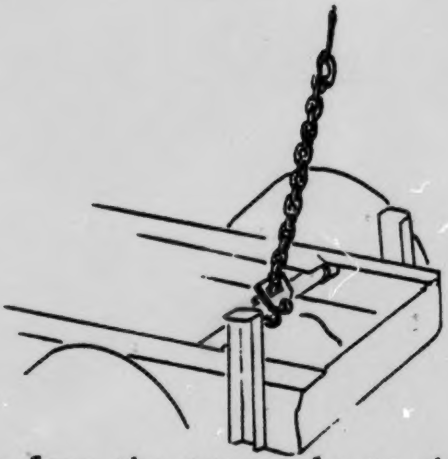


JOB STEPS

B. Use vise-grips to slowly let back the spring until tension is released.

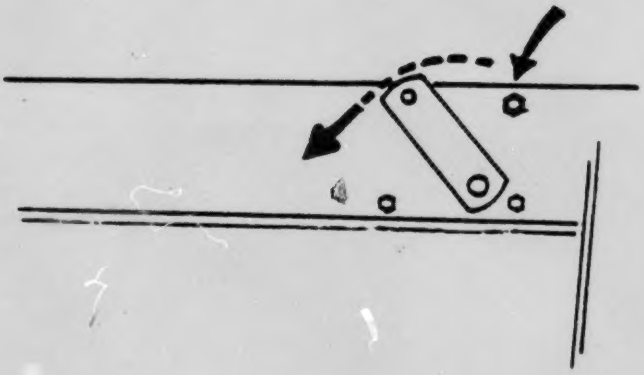


7. Use hoist to support back end. Put the chain around the cross shaft.



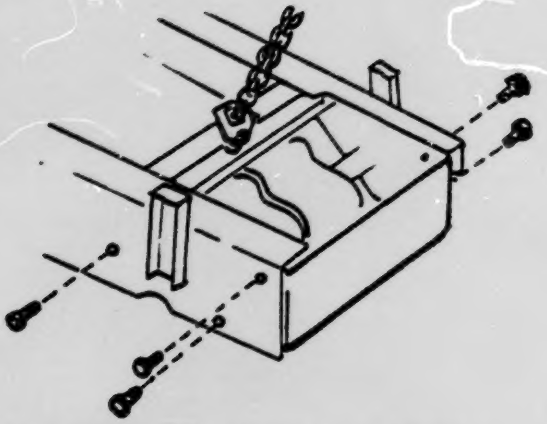
8. To remove 6 bolts from the transaxle to the transmission, follow these steps:

A. Push brake arm forward to remove one right side bolt.

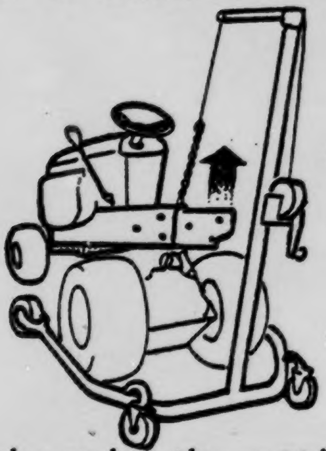


JOB STEPS

B. Remove other bolts.



C. Use hoist to raise frame above transsaxle.



D. Put blocks under the cutting unit, then unhook hoist and pull away.
E. Shift into neutral and wheel away the transaxle.

NOTE: Now you can do any repairs needed.

9. To replace transaxle, begin by rolling the transaxle back under the frame.

   A. Get help to guide the shift lever into the slot.
   B. Replace the 6 bolts.

10. Replace pin in the brake arm.

11. Replace pin in brake pedal linkage to cross shaft.

JOB STEPS

12. Check that variator control is in "FAST" position and reconnect idler spring.

    A. Use a wire on vise grips to pull and hook it.

13. Replace belt on variator sheave following these steps:

    A. Depress clutch pedal.
    B. Raise secondary belt idler (D) and install belt on transmission-driven sheave.

14. Install gas tank and put gas in.

    A. Put gas line in the same place as you took it out.
    B. Put on the wire to seat sensor.
    C. Turn fuel on.

15. Replace fender deck.

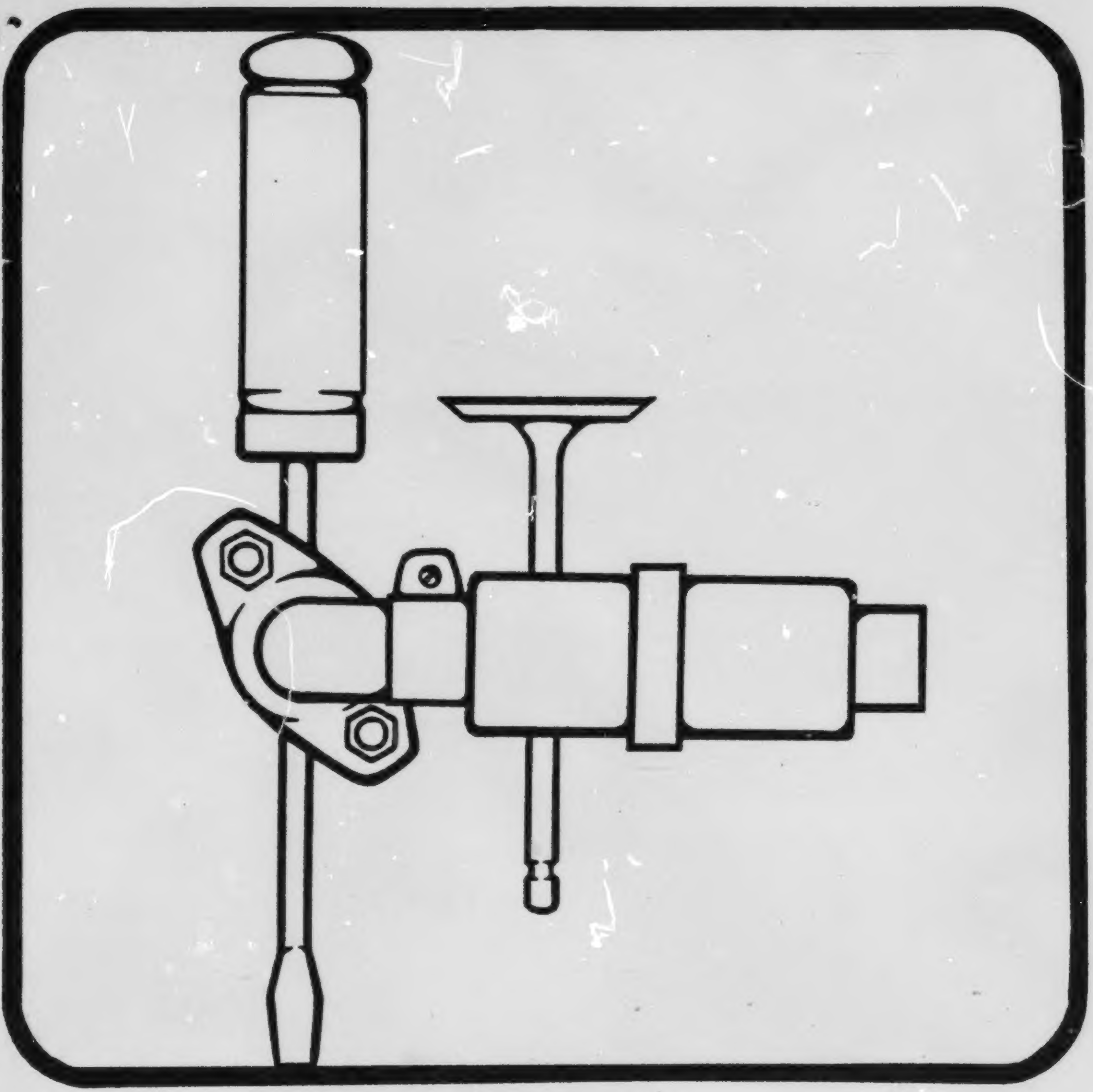
    A. Have someone help you.
    B. Put on the same way you took it off.
    C. Don't forget to plug in seat sensor plug.
    D. Put 4 bolts (one with spacer) back on.
    E. Replace shift handle.
    F. Replace 2 foot pedals.

16. Start and make sure it shifts into gear.

    A. Use hoist to lift rear end when testing to see if it shifts into gear.

17. Use the green hoist and blocks if you need to lift the tractor for any reason!

18. Have your instructor check your work.



small engine repair

unit: GEAR BOXES AND DRIVE TRAINS

capital area career center

module: 7501 10 002 date: June 1977 level: I

skill title: Remove and Replace Drive Belt Simplicity Model 4108 8 H.P. Tractor (Also Model 4008)

developed & written by: Paul Loukides

visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to remove and replace the drive belt on a Simplicity Tractor (Models 4108 and 4008).

IN ORDER TO DO THIS YOU WILL NEED:

A Simplicity Tractor (Model 4108 or 4008)

1 socket set

1 open end wrench set

1 box end wrench set

1 torque wrench

1 drive belt

Hoist

Safety Jackstands

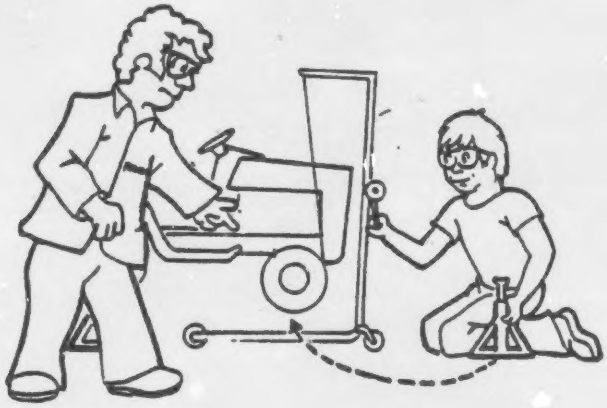
WE WILL KNOW YOU CAN DO IT WHEN:

The replaced drive belt does not slide or jerk, and transfers power so that the tractor moves smoothly.

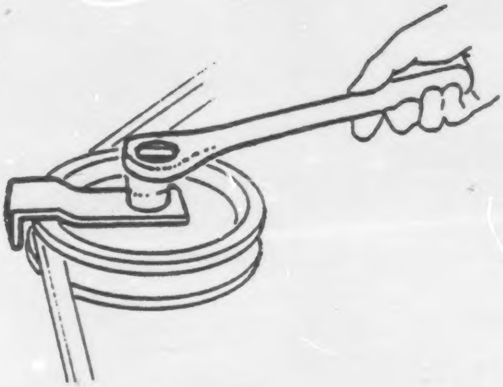
JOB STEPS

1. Raise tractor and place safety jackstands under rear and front axles. Have your instructor show you how.

   WARNING: Do not start work on the tractor until your instructor has inspected your safety precautions.

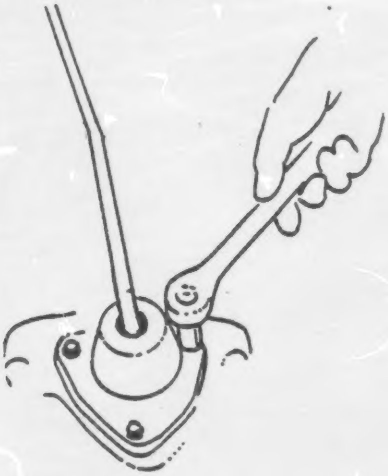


2. Using a socket wrench, loosen the belt stop from the clutch idler pulley.



JOB STEPS

3. Remove three (3) capscrews to disconnect the gearshift lever at the transaxle. Be careful that no dirt enters the transaxle. Use a clean cloth to plug the hole if necessary.



4. Press the clutch pedal down to remove tension from the drive belt. Remove the belt from the engine drive pulley and the clutch idler pulley.

5. Turn the belt sideways to slip it off the transaxle pulley and remove the belt from the tractor.

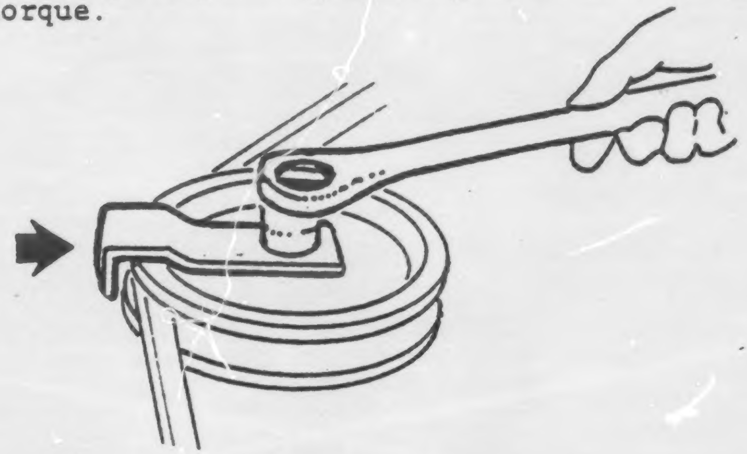
   NOTE: It may be necessary to loosen the transaxle pulley and press it further onto the shaft to gain enough room between the frame and pulley to remove belt.

6. Place a new belt on the transaxle pulley. If you needed to loosen the pulley to remove the old belt, place the new belt on the pulley and then return the pulley to its original position and retighten.

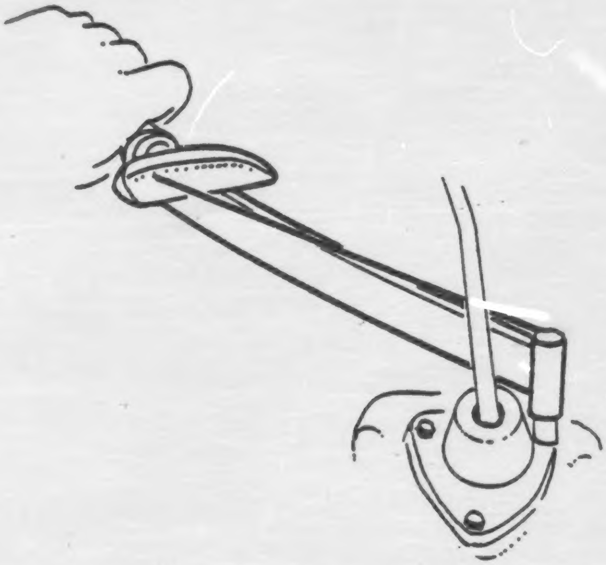
7. Press the clutch pedal down and replace the belt on the engine drive pulley and the clutch idler pulley.

JOB STEPS

8. Reinstall the idler pulley belt stop. The idler pulley belt stop should be positioned so that it is facing side to side on the pulley. Tighten capscrew with 18-22 ft. lbs. of torque.

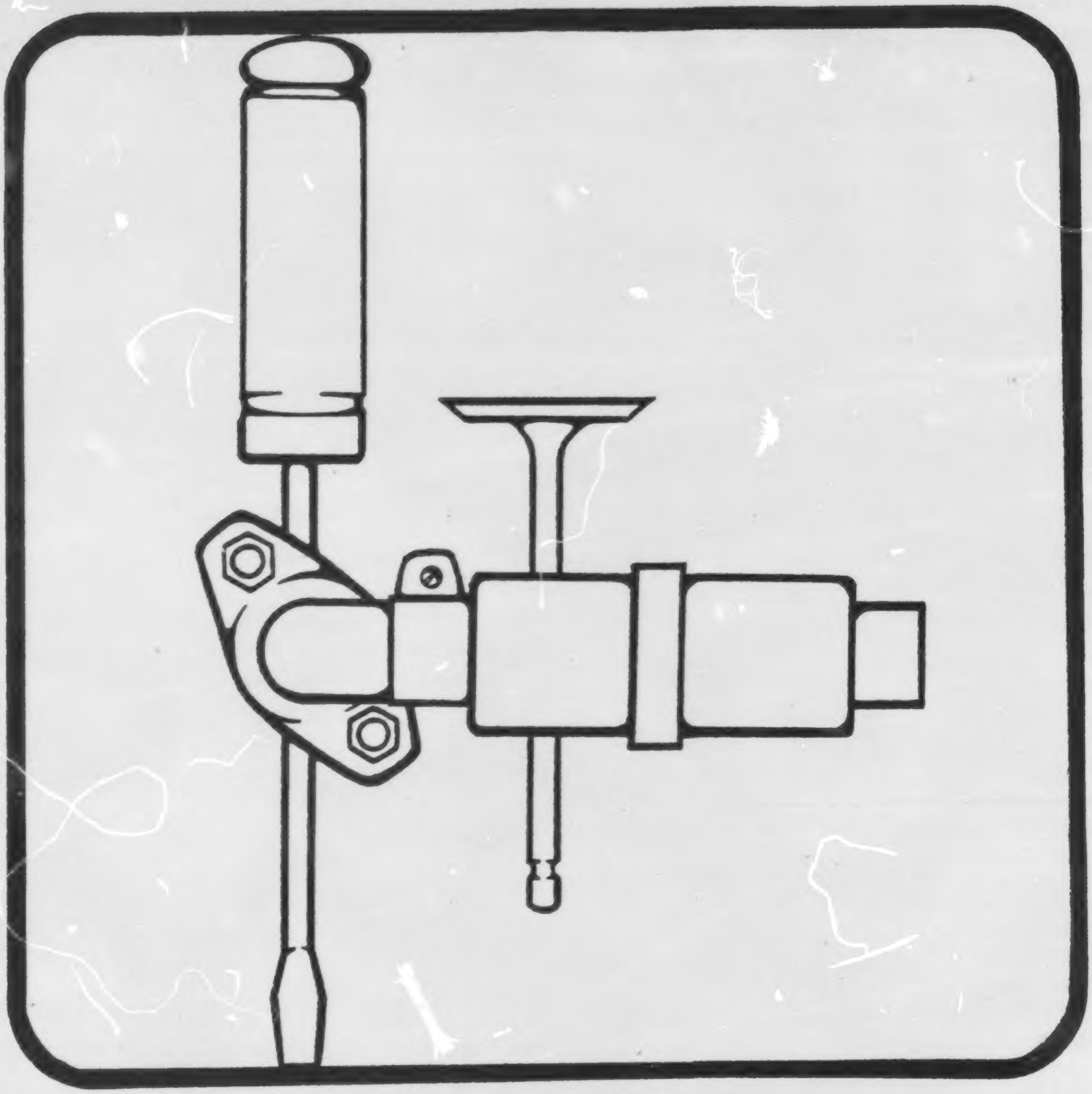


9. Reinstall shift lever. The shift lever must be installed with the grooved side of the shift lever hub to the right (brake side).
10. Torque shift lever capscrews to 80 to 108 In. pounds.



11. Now that you have replaced the drive belt, you may want to check clutch and brake adjustments. Ask your instructor.

12. Clean up your work area.



small engine repair

unit: GEAR BOXES AND DRIVE TRAINS

capital area career center

module: 7501 10 003 date: July 1977 level:

skill title: Remove and Replace Gear Box Jacobson Riding Mower (Model 42635)

developed & written by: Paul Loukides

visuals by: Dave Wehrwein

WORD GUIDE

FUNCTIONS - Works; operates

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to remove and replace the gear box (transmission) on a Jacobson riding mower (model 42635).

IN ORDER TO DO THIS YOU WILL NEED:

A Jacobson riding mower

1 socket set

1 open end wrench set

1 set hex keys

WE WILL KNOW YOU CAN DO IT WHEN:

The replaced gear box functions smoothly through the entire range of shift positions (forward, neutral, and reverse).

WORD GUIDE

SLACK - Loosening

REASSEMBLE - Put back together

VERTICAL - Straight up and down

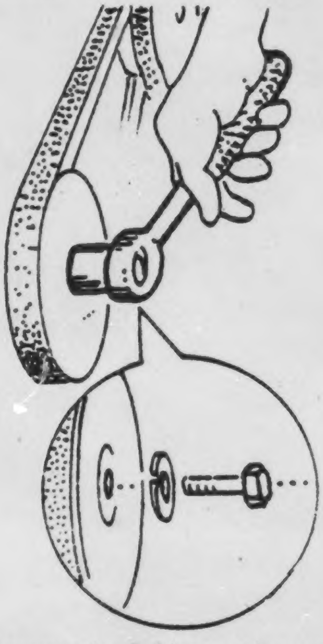
WORN - Much used, old, in need of repair or replacement.

JOB STEPS

1. Place mower in vertical working position following steps outlined by your instructor.

WARNING: Do not start work on the mower until your instructor has inspected your safety precautions.

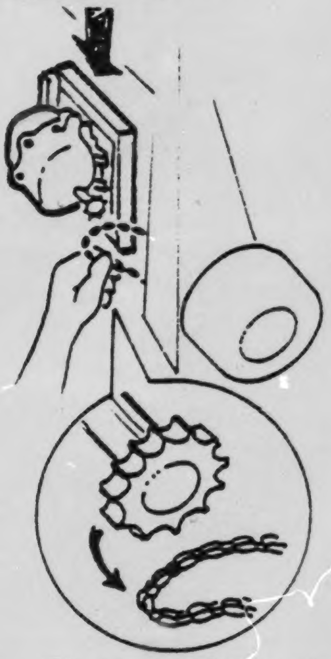
2. Unscrew the threaded ball knob of the shift lever by hand and remove the engine box panels (both right and left sides).
3. Using a socket wrench, remove the hex nut and lockwasher holding the transmission pulley in place and then remove the pulley from the transmission shaft. Do not remove the transmission belt unless it is worn.



4. Remove the four nuts holding the transmission to the frame and slide the unit toward the rear of the mower to gain enough slack to remove drive chain.

(See illustration on top of next page)

JOB STEPS



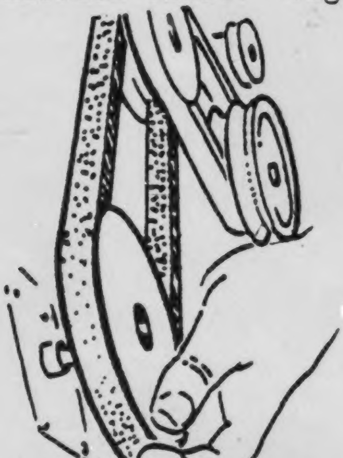
5. Remove gear box.

6. To reassemble the unit, first replace the gear box on its mounting bolts.

7. Replace chain. Tighten bolts. The chain should have no more than 1/2" of give when finger pressure is applied in the middle.

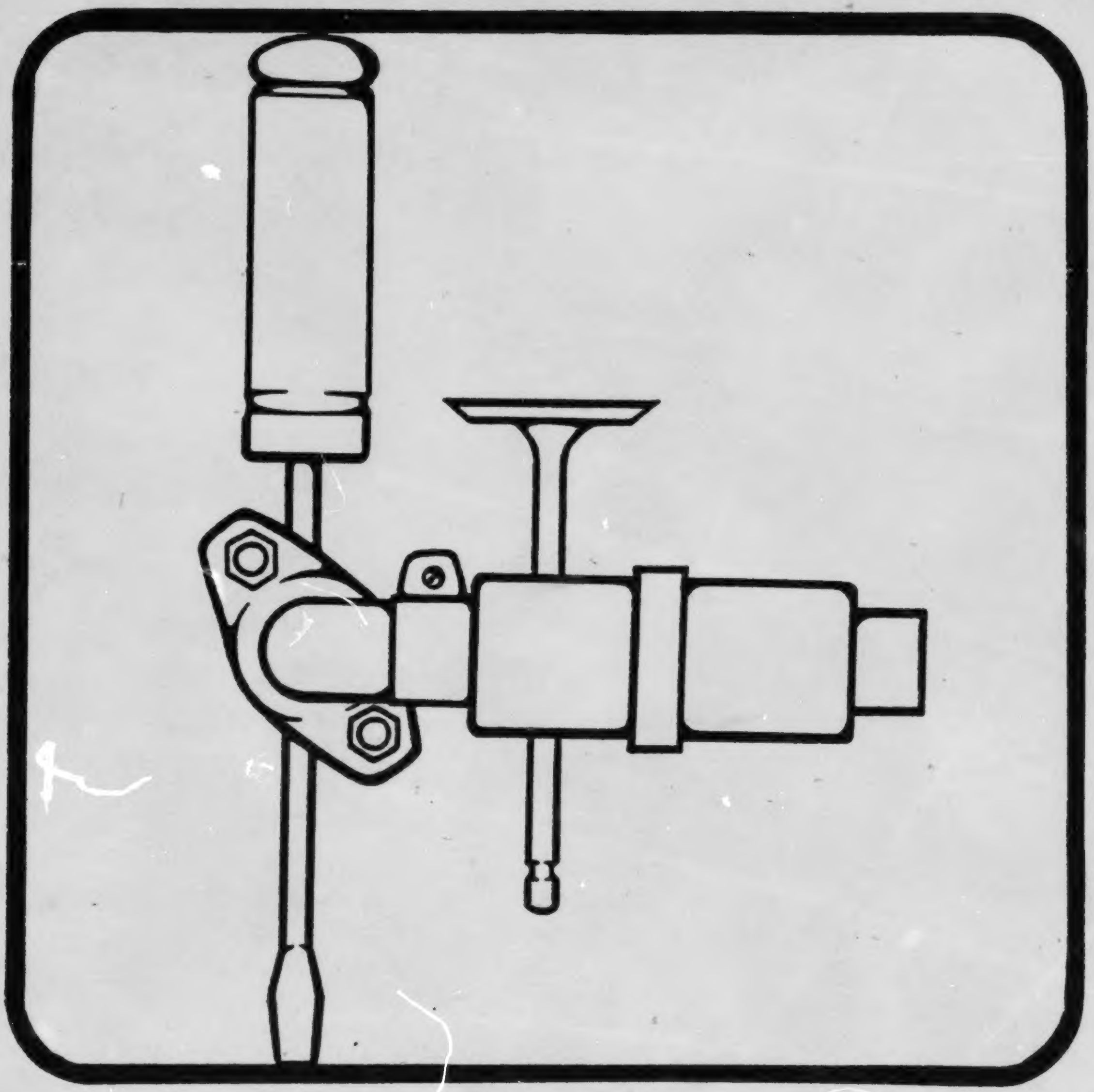
   NOTE: It may be necessary to adjust chain tension by moving the transmission mounting plate. The adjusting bolt is located under the frame, above the cutting deck, on the right side of the mower.

8. Replace the belt on the transmission pulley and mount the pulley on the transmission shaft. Tighten the hex nut.



9. Replace the engine box panels and the shift level ball.

10. Lower the mower and test the transmission.



small engine repair

unit: GEAR BOXES AND DRIVE TRAINS

capital area career center

module: 7501 10 004 date: June 1977 level:

skill title: Adjust Variator and Brake Linkage (John Deere Tractor 200 Series)

developed & written by: Paul Loukides

visuals by: Steve Bramer

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to adjust the variator linkage and brake linkage on a John Deere Tractor (200 series).

IN ORDER TO DO THIS YOU WILL NEED:

A John Deere Tractor (200 series)

1 socket set

1 plier

1 screw driver set

WE WILL KNOW YOU CAN DO IT WHEN:

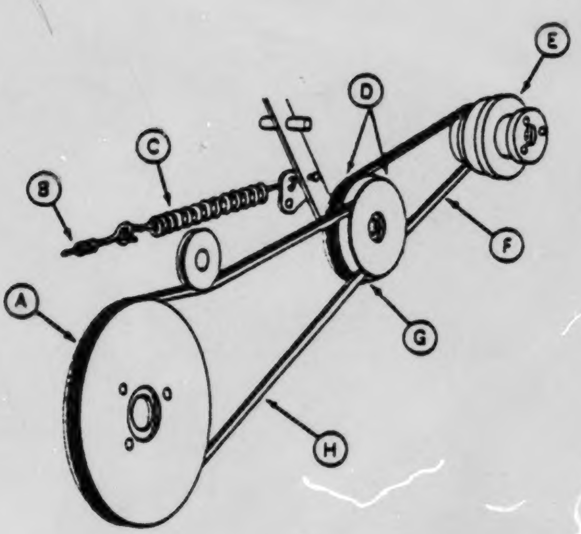
You have adjusted the linkages so that:

A. The speed control and clutch operate according to specifications.

B. Pressure on the brake pedal is enough to stop machine.

INFORMATION

Study the drawing below. Go back to look at it when doing the job steps. It shows you all the parts of a variator linkage.



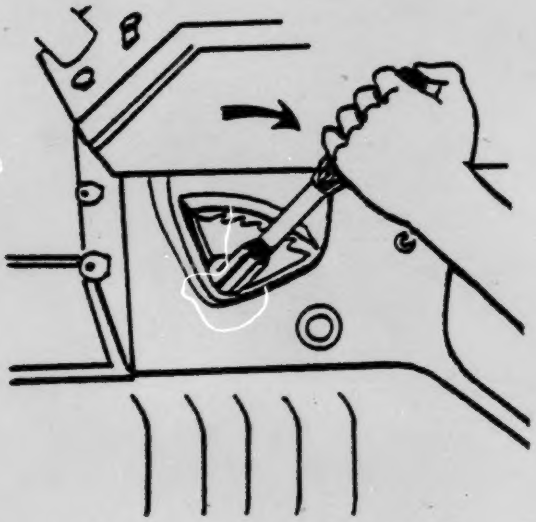
M16646N

A—Driven Sheave
B—Eyebolt
C—Spring
D—Half Sheave
E—Drive Sheave
F—Primary Belt
G—Center Sheave
H—Secondary Belt

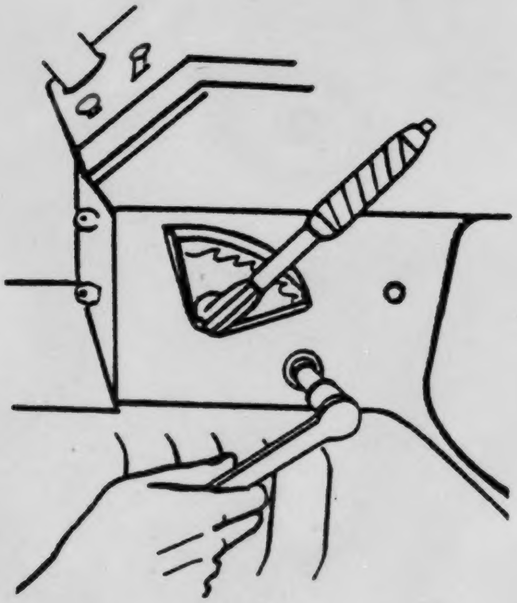
JOB STEPS

Variator linkage:

1. Place variable speed control in notch 5 on the quadrant (third notch from the front of the tractor).

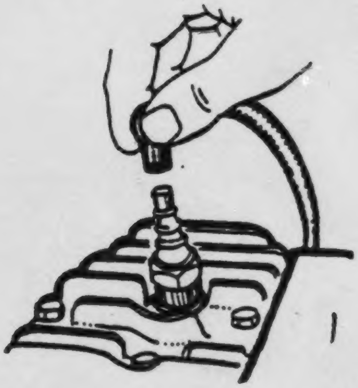


2. Pry button from adjusting hole below the variable speed control and, using 3/4 inch socket wrench, loosen cap screw one or two turns.

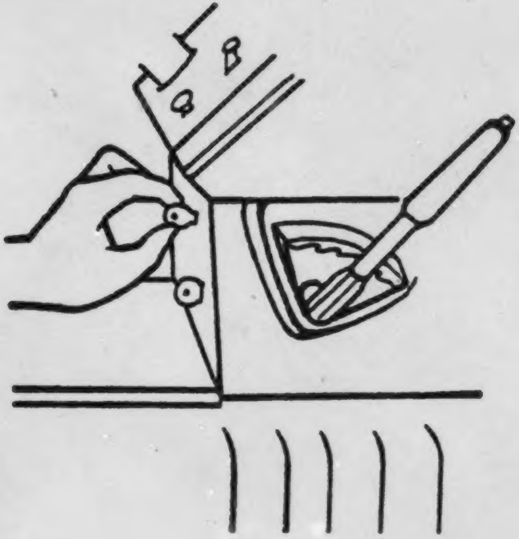


JOB STEPS

3. Disconnect sparkplug cable and ground.

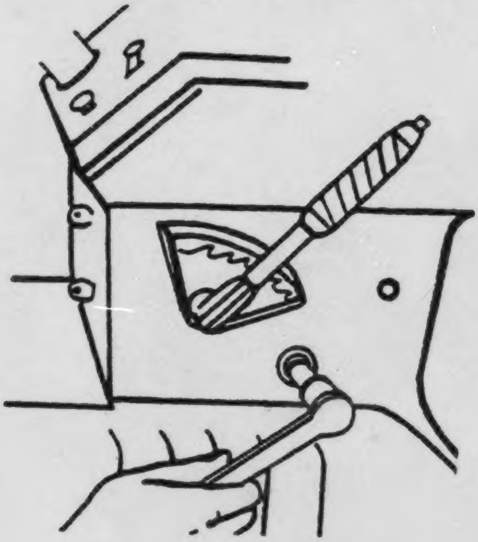


4. To crank engine several revolutions with starter, turn ignition key. Crank until the clutch pedal raises as high as it will go.

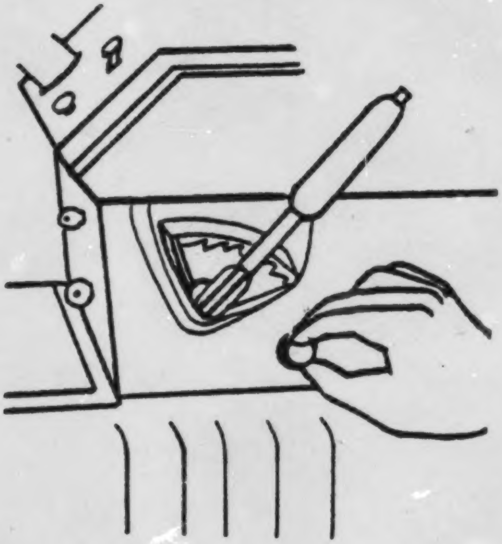


JOB STEPS

5. Take up slack in linkage by pushing down on cap screw.



6. Tighten cap screw and replace button plug in adjusting hole.

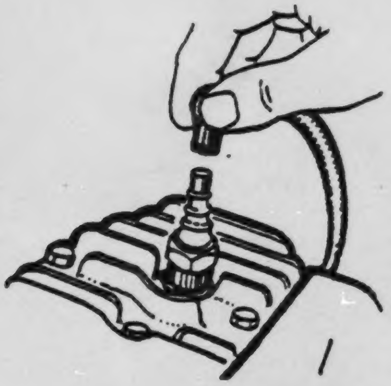


WORD GUIDE

CLEVIS - U-shaped end.

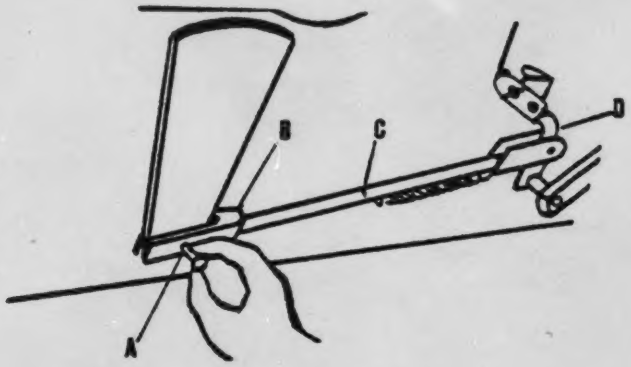
JOB STEPS

7. Reconnect sparkplugs and ground.



Brake adjustment:

1. Remove cotter pin and drilled pin (A) and then turn clevis (B) on brake rod (C) until brake is in first notch of park lock (D).



2. Replace drilled pin (A) and replace cotter pin.

3. Clean up your work area.

small engine repair

unit: Sharpening and Grinding Mowers

capital area career center

module: 7501 11 001 date: 6/77 level: III

skill title: Sharpening Rotary Mower Blades and Balance

developed & written by: Jim Pitts

visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to sharpen and balance a rotary mower blade.

AND IN ORDER TO DO THIS YOU WILL NEED:

Rotary mower

Blade

Bench and pedestal grinder, wire wheel

Blade balancer

Impact wrench and socket

Bench vise

File

WE WILL KNOW YOU CAN DO IT WHEN:

The blade has an even sharp edge without burr and is balanced so it will not vibrate when working properly on the mower.

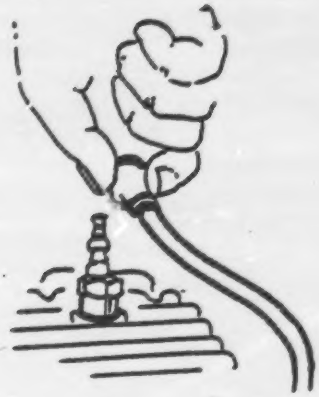
INFORMATION

To cut properly, a power lawnmower must have a sharp and balanced blade. If the blade is dull, it will just beat down the grass. If the blade is not balanced, the engine will vibrate and could become damaged.

JOB STEPS

1. Take all equipment and go to your work area.

2. Remove sparkplug wire from sparkplug.

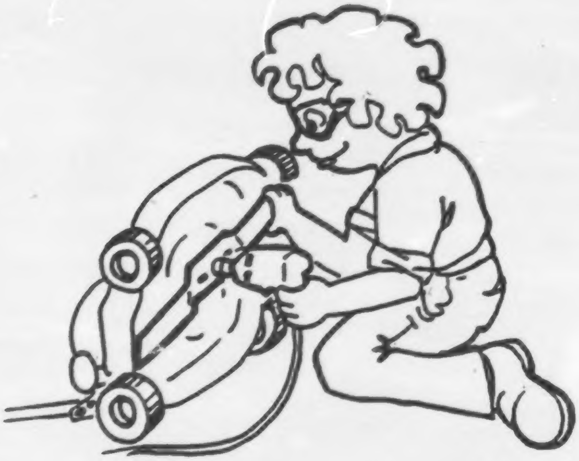


3. Lift the mower onto the bench, (get help, if needed).

4. Tip the mower so that the valve chamber breather is up.

   NOTE: If the breather is down, the oil will run down into the valve chamber and into the head.

5. Get an impact wrench and proper size six point socket. Put the wrench on the blade bolt or nut and hold the blade firmly with one hand while you use the other hand to run the impact wrench.

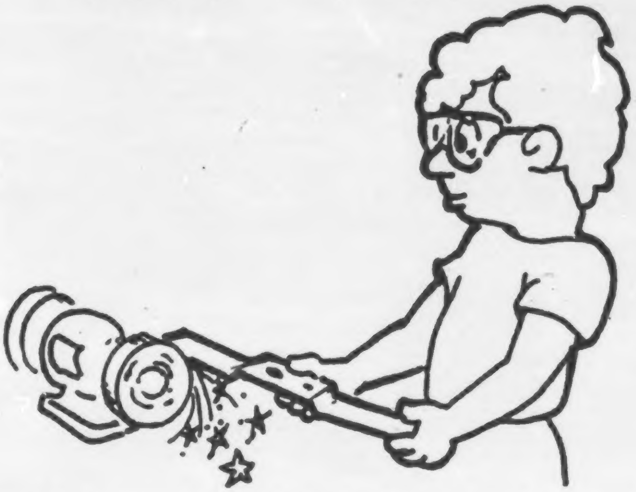


NOTE: When you get off the bolt or nut notice the proper place for the blade and any washers on the blade.

JOB STEPS

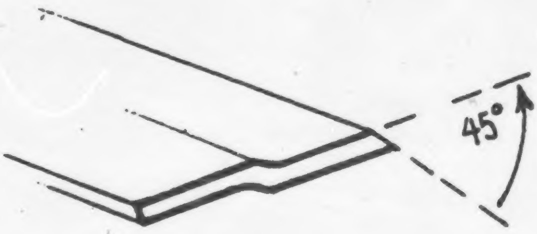
6. Using a wire wheel, clean grass and dirt off of the blade. Ask your instructor to grind one side to demonstrate how to grind the blade.

7. Grind the blade flat on the cutting edge to remove any nicks. Grind the same distance on both ends of the blade.



8. Now, turn the blade over and grind approximatley a 45° angle on the blade.

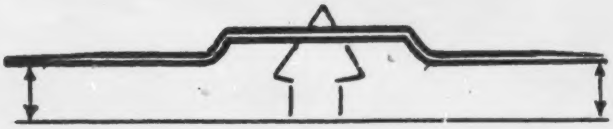
CAUTION - Watch the sparks as you are grinding the blade. When you first start grinding, the sparks will be going in all directions. When you come to a sharp edge, the sparks will follow down the bottom side of the blade.



JOB STEPS

9. Have the instructor explain about the face of the blade.

10. Put the blade on the balancer. One end may be heavy. The end that is down is the one that will have to be ground until the blade balances.

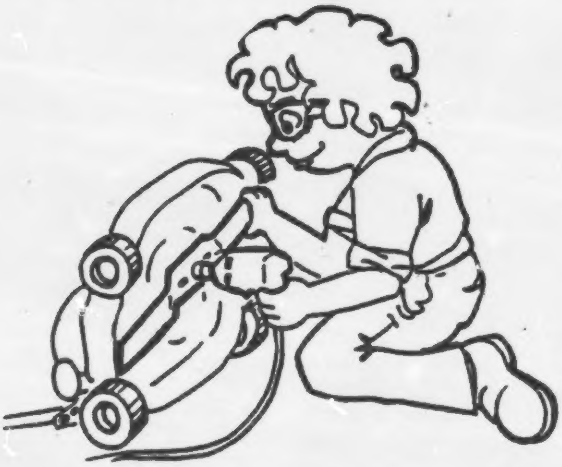


11. Have your instructor check the balance.

12. Check any fiber washers that go on the blade. Replace if needed. Also, replace any broken hubs.

13. Now, put the blade and washers back on in the proper order. Check to see if the sparkplug wire has been removed.

14. Using the impact wrench, tighten the blade.



JOB STEPS

15. Ask the instructor to inspect the blade before you try to start the engine. Never start the engine if the instructor hasn't checked the blade.

16. If needed, get help to put the mower on the floor.

17. Check oil and fuel.

18. Be sure there is nothing under the mower when you start it up. Then, start and adjust.

19. Stop engine and clean unit up for customer pick-up.